ECONOMIC AND SOCIAL COMMISSION FOR WESTERN ASIA (ESCWA)

COMPETITIVENESS OF THE ICT SECTOR IN THE ARAB REGION:

INNOVATION AND INVESTMENT IMPERATIVES

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ABBREVIATIONS

CAGR	Compound annual growth rate
CITC	Communication and Information Technology Commission
DESA	United Nations Department of Economic and Social Affairs
GCC	Gulf Cooperation Council
ICT	Information and communication technology
IPB	ICT Price Basket
IPR	Intellectual property right
ITU	International Telecommunication Union
MENA	Middle East and North Africa
OECD	Organisation for Economic Co-operation and Development
R&D	Research and development
SME	Small and medium enterprise
TFP	Total factor productivity
TFFM	Task Force on Financial Mechanisms for ICT for Development
UIS	UNESCO Institute for Statistics
UNCTAD	United Nations Conference on Trade and Development
WEF	World Economic Forum
WIPO	World Intellectual Property Organization
WSIS	World Summit on the Information Society

Executive summary

Information and communication technology (ICT) is a key driver of productivity and growth for many sectors of the economy. At this juncture, it is difficult to envision functional, modern and progressive business, finance, health, education, public or other sectors without a significant ICT component. This important role has encouraged many developed and developing countries to place ICT at the heart of their economic policies. This study sheds light on innovation and investment in the ICT sector and explores policy measures that could be adopted to improve its competitiveness in the Arab region.

Countries with well-developed, innovative and competitive ICT sectors achieve better productivity and growth rates than those with underdeveloped sectors. By improving efficiency, ICT can streamline a sector's workforce; however, it is still construed as a prime job creator. Ordinary jobs, which may be lost as a result of modernized work methods, are replaced with others that require a different set of skills. Recent estimates suggest that the Internet has created 2.6 new jobs for every job lost. Key drivers of a mature ICT sector are infrastructure (computing and networking equipment, devices, fixed and wireless broadband technologies), adequate skills, legislation that enables the flow of information through technology transfer, intellectual property protection, sound government and well-developed financial markets.

An increasing number of developing countries are seeking to put ICT at the centre of their development strategies. Some try to leapfrog developed countries by adapting strategies and policies that have been proven to work, thereby avoiding pitfalls and mistakes committed by others and implementing cutting-edge technologies. Countries in the Arab region actively pursuing similar goals include Egypt, Jordan, Morocco and the countries of the Gulf Cooperation Council (GCC). These ESCWA member countries have put ICT at the forefront of their growth agendas. Out of this group, some, including the United Arab Emirates, have initially focused on becoming outsourcing hubs rather than stand-alone producers of ICT products and/or services. Other countries in the Arab region are less active in the development and implementation of comprehensive, effective ICT strategies and policies that could foster productivity and growth.

Problems hindering the development of a competitive ICT sector in the Arab region include the following: (a) an incomplete and inefficient broadband infrastructure; (b) among the lowest number per capita of research and development (R&D) researchers in the world; and (c) an inefficient knowledge of the elements that promote innovation and enhance investment in the ICT sector. Other challenges include barriers introduced by public as well as private sector enablers. These barriers are as follows: (a) a lack of government incentive programmes; (b) ineffective, non-existent or restrictive regulatory environments; (c) inadequate ICT infrastructure; (d) finance requirements and mechanisms; and (e) economic constraints.

There are several determinants for the establishment of a competitive ICT environment at the national level. These are infrastructure, education, institutional quality, innovation and investment. The first determinant implies that a healthy ICT ecosystem requires a solid, resilient and affordable high-speed broadband infrastructure. In turn this broadband infrastructure cannot function without a resilient electricity network. Another fundamental driver of ICT competitiveness is education. The three most essential prerequisites of this second determinant are: (a) high-quality secondary and tertiary education systems; (b) widespread e-skills; and (c) digital literacy. The conditions for ensuring institutional quality, which represents the third determinant, are the existence of a clear political vision, the readiness to carry out regulatory reform and to implement reforms of financial regulations and company law, and a willingness to enforce the rule of law.

The fourth determinant is innovation. This study sees innovation as an ecosystem that includes entrepreneurs, large and small companies, accelerators, venture capitalists, business angels and government intermediaries. If one of its key players goes missing, innovation will fail to meet its goals. ICT is also seen as an ecosystem, extending over several layers, from the physical to the logical and from the services to the

content layer. A successful policy for innovation in ICT must take into account all the players and layers of these two ecosystems.

The nature of innovation in ICT is changing very rapidly. It has evolved from a stand-alone process into a granular, modular, cooperative and distributed activity. Nowadays, collaborative ventures, such as open source software, creative commons and distributed co-creation exist alongside the more traditional form of in-house R&D.

The role of Governments in promoting innovation is also changing, as they can no longer dictate the direction of innovation. Policymakers now resort to bottom-up reforms that facilitate the innovation process. These include the following: (a) supply-side policies, such as promoting university research and technology transfer, offering tax credits, creating living labs, incubators and venture capital funds; (b) demand-side policies, such as pre-commercial procurement; and (c) policies to improve the business climate, such as better governance, simplified regulation and innovation-friendly policies.

The final determinant is investment. Promoting investment in ICT requires a fertile business environment and a solid knowledge of the ICT ecosystem. Investors place broadband connectivity and resilient energy networks at the top of their priorities, closely followed by the strong rule of law and the enforcement of intellectual policy rights. The evolution of new technologies, such as cloud computing, has added cyber legislation, cyber security and data protection to the fray.

Developing countries have often focused on venture capital to boost investment in ICT. Similarly, Arab countries seem to be very attentive to venture capital, launching many funds geared towards the promotion of investment in the ICT sector. While such moves are a step in the right direction, they cannot succeed without such complementary measures as investment in and improvement of broadband infrastructure, as well as the upgrading of the skills of the labour force.

The recommendations set forth below, which are targeted at various stakeholders, have the potential to boost competitiveness, innovation and investment in the ICT sectors of the countries of the Arab region.

(a) *Target: Governments*

(i) Place the development of a competitive national ICT sector at the core of a sustainable development strategy and commit the human and financial resources necessary to achieve this goal;

(ii) Develop and/or improve the legal and regulatory frameworks which provide the enabling environments that are necessary for the development of a healthy and sustainable ICT sector;

(iii) Undertake steps to liberalize and foster competition in national ICT sectors, while taking care not to create private sector monopolies.

(b) *Target: Multiple stakeholders*

(i) Develop sources of funding for startups as well as financing modes and mechanisms aimed at encouraging investment in ICT activities. Proposed actions include stimulating equity and debt financing, establishing primary and secondary capital markets, encouraging a more active involvement for the banking sector, promoting business angel networks, creating government support programmes as well as security of assistance from regional and international specialized organizations;

(ii) Deploy and/or improve national and regional physical infrastructure, putting an emphasis on the development of high-speed broadband connectivity;

(iii) Improve education and skills by investing in basic and higher education and vocational training, and by connecting R&D teams from the region with counterparts in developed countries;

(iv) Adopt a bottom-up, holistic view of innovation in the ICT sector. To succeed, such a view requires the existence of a knowledge triangle that brings together education, research and industry;

(v) Use cutting edge technologies to leapfrog over the technological achievements of developed nations. Countries in the Arab region can bypass costly and lengthy technological transition periods by adopting and implementing the very latest technologies;

(vi) Adopt a "smart specialization" strategy by carefully selecting the layers of the ICT ecosystem that are deemed to have the highest chance of success. Innovation strategies must be based on local specificities and tailored to the peculiarities of national and regional markets;

(vii) Seek economies of scale, preferably at the regional level. As an example, countries that have funds to invest in R&D but lack researchers can partner with countries that have researchers but no funds. This effort requires the development of a region-wide ICT strategic plan that would identify prospects on a country-by-country level, as well as regionally.

I. INTRODUCTION

Information and communication technology (ICT) plays an increasingly important role in a multitude of sectors and economic activities, a fact that has encouraged many developed and developing countries to place it at the heart of many of their economic policies.

This study sheds light on innovation and investment in the ICT sector and explores policy measures that could be adopted to improve its competitiveness in the Arab region. Focus areas include the following: (a) ICT as an important driver of productivity and economic growth; (b) the contribution of ICT to the knowledge economy; (c) the role and impact of innovation on the ICT sector; (d) the key pillars of successful innovation policies; (e) innovation, investment and competitiveness of the ICT sector in the Arab region; and (f) measures to promote innovation and investment in the ICT sector of the member countries of Economic and the Social Commission for Western Asia (ESCWA).

A. METHODOLOGY

This study relied on desk research that focused on the following subjects:

(a) The contribution of ICT to economic growth and total factor productivity;

(b) Innovation in the ICT field, the measurement of the impact of innovation on national economies as well as innovation policies in emerging economies and developing countries;

(c) Emerging applications and business models in the ICT ecosystem;

(d) Promoting investment in the ICT sector;

(e) Smart specialization.

For an exhaustive list of material used in the preparation of the study, please refer to the bibliography.

B. STRUCTURE OF THE STUDY

This study focuses on innovation and investment as two elements that are essential for creating and maintaining competitiveness in the ICT sector in the Arab region. These two imperatives depend on a number of policy actions. ICT innovation is dependent on the interaction of research, education and entrepreneurship and can be promoted through incubators and living labs. Investment in the ICT sector needs the strong protection of property rights as well as the availability of a variety of public and private funding models. The interaction between these two imperatives can boost the competitiveness of the ICT sector, both at the regional and global levels.

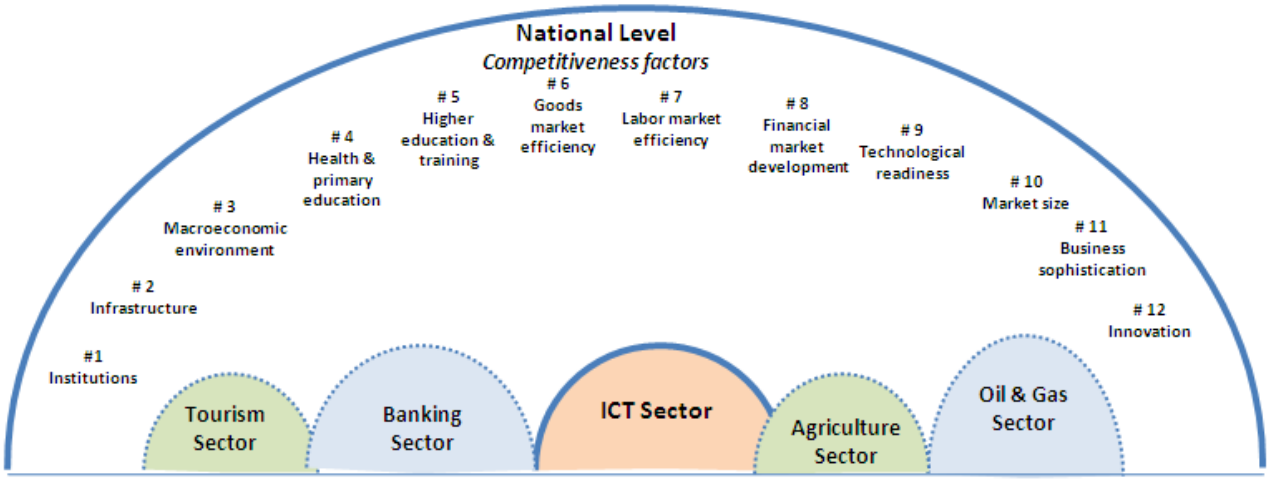
The study starts with the status of the ICT sector in the Arab region and identifies current priorities for its development. It continues with a discussion of the determinants of the competitiveness of the ICT sector and its contribution to the knowledge economy. Chapter IV defines innovation, innovation policy, various innovation models, as well as the current levels of innovation in the Arab region. The study then explores the main drivers of investment, from institutional to market conditions, and investigates whether the business environment in the Arab region is favourable to the creation of a competitive ICT sector. The study concludes with recommendations that have the potential to boost competitiveness, innovation and investment in the ICT sectors of the countries of the Arab region.

The figures below contain the conceptual framework that links together the various elements of the study. Figure 1(A) depicts the 12 pillars of competiveness according to the World Economic Forum. The competitiveness of a country is linked to its potential for growth. Similarly, the competitiveness of the ICT sector is linked to that sector's potential for growth vis-à-vis either other economic sectors nationally or ICT sectors in other countries.

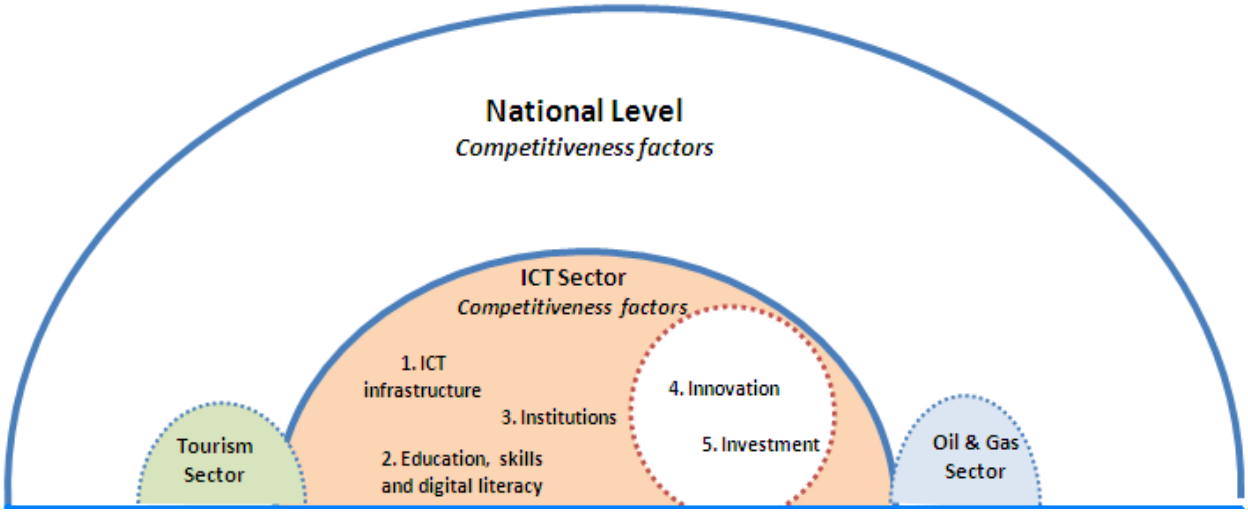
Figure 1(B) depicts the five factors/determinants identified within the study as being essential for the establishment of a competitive ICT sector in the Arab region. Out of these five, the study focuses on the two most important factors that are hindering the competitiveness of the ICT sector in the Arab region, namely, a lack of innovation and a poor investment climate.

Figure 1. Conceptual framework

A. Competitiveness at the national level



B. Competitiveness at the ICT sector level



Source: ESCWA, based on WEF, 2013.

C. Definitions

This section provides definitions for the most prominent components of the study. It is important to note that more than one definition may be available for each of these components. The definitions provided below are those that were deemed to be most relevant to the contents and arguments herein.

1. *Information and Communication Technology*

ICT consists "of the hardware, software, networks, and media for the collection, storage, processing, transmission and presentation of information (voice, data, text, images), as well as related services".[1]

2. *ICT ecosystem*

The term ecosystem refers to the physical and biological components of an environment. An ICT ecosystem encompasses the active and passive components of communication and data networks, computer and communication hardware, software platforms and applications, digital content, services as well as developers, regulators, entrepreneurs, investors, users and consumers.

3. *ICT sector*

Frequent technological innovations and advances in ICT require the definition of the ICT sector to be revised periodically in order to include new processes, products and services. A widely used definition of the ICT sector was originally proposed by the Organisation for Economic Co-operation and Development (OECD) in 1998 and revised slightly in 2002 to reflect the constantly changing nature of the sector. The OECD definition combines the manufacturing and delivery of goods and services that are related to electronic data capturing, transmission and display. It is broad in nature, encompassing a large array of technologies which extend from office equipment, computers, computer peripherals and software to telecommunications, radios, televisions and more.[2]

4. *ICT industry*

In comparison to the ubiquitous OECD definition of the ICT sector, a common definition for ICT industry is harder to come by. An obvious explanation is that the very broad definition of the ICT sector encompasses all the elements of the slightly narrower definition of the ICT industry. The definition of ICT industry advanced in a document prepared by the Department of Communications, Information Technology and the Arts in Australia is very closely related to the OECD definition of the ICT sector, eliminating a few of its elements, such as office equipment.[3] This study focuses on the broader nature and definition of the ICT sector and only uses ICT industry when quoting another source.

5. *Knowledge economy*

Knowledge economy refers to the "use of knowledge to produce economic benefits. The phrase came to prominence in New Zealand in the mid to late 1990s as a way of referring to the manner in which various high-technology businesses, computer software, telecommunications and virtual services educational and research institutions, can contribute to a country's economy".[4]

6. *Innovation*

An easy definition of the word innovation is "the process by which individuals and organizations generate new ideas and put them into practice".[5] A simple search on the Internet yields a multitude of

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[1] World Bank, 2009.

[2] OECD, Glossary of Statistical Terms, available from http://stats.oecd.org/glossary/detail.asp?ID=3038.

[3] Mapping Working Group. An Overview of the Australian ICT Industry and Innovation Base. Available from http://www.archive.dcita.gov.au/__data/assets/pdf_file/0015/10446/An_Overview_of_the_Australian_ICT_Industry_and_Innovation_Base.pdf.

[4] http://municipaltoolkit.org/en/thesaurus.

[5] United States, Strategy for American Innovation. Available from http://www.whitehouse.gov/innovation/strategy/introduction.

alternative definitions. An increasingly acceptable consensus is that innovation, however defined, is not limited to the marketplace, but also occurs among end users and without any need for an research and development (R&D) process.

The ontological element of innovation is approached in the broadest possible sense, leaving space for user-generated innovation, automated innovation, industrial R&D projects and public investment. The teleological element simply states that a new product is to be considered innovation only to the extent that it contributes to social welfare in the long run, without depriving society of resources that could have been more usefully allocated elsewhere. In a nutshell, innovation's main features are efficiency and progress.

7. *Investment*

The term investment generally refers to the allocation of a sum of money to the purchase of a good or service, or the launch of a business activity, with the idea that such action will generate profit in the future. For the purposes of this study, investment in ICT is defined as the act of financing a new business venture that promises to generate positive returns, regardless of whether the investor is the entrepreneur who owns the innovative ICT solution or is a venture capitalist or angel investor that believes in that idea's potential.

8. *Entrepreneurship*

Entrepreneurs implement innovative ways of producing existing or entirely new goods and services, and of placing them on the market or any other location where exchange can take place. De Soto defines entrepreneurship as the "typically human ability to recognize opportunities for profit which appear in the environment and to act accordingly to take advantage of them".[6] Based on this definition, an entrepreneur might not be the developer of an innovative idea, but simply an individual who is able to bring that idea to market in a successful way. This quality becomes very important when innovative ideas and products are developed simultaneously by more than one individual.

9. *Competitiveness*

There is no consensus on the definition of competitiveness. The most common definitions focus on a country's ability to sustain global competition through enhanced efficiency, productivity and growth. These definitions conclude that there is a strong rivalry among players in a given industrial sector. This study does not agree with this assessment for the following reasons: (a) it is not concerned with competition at the level of sectors; (b) the balance between static and dynamic competition, price rivalry and innovation, and even private competition and public investment is still subject to a vigorous debate, especially in high fixed-cost sectors, including the ICT sector. This study adopts the broader definition of competitiveness advanced by the European Competitiveness Report 2010, which states that, for an industrial sector, the "main competitiveness criterion is maintaining and improving its position in the global market".[7]

[6] De Soto, 2009.

[7] European Commission, 2010.

II. ICT SECTOR IN THE ARAB REGION: AN OVERVIEW

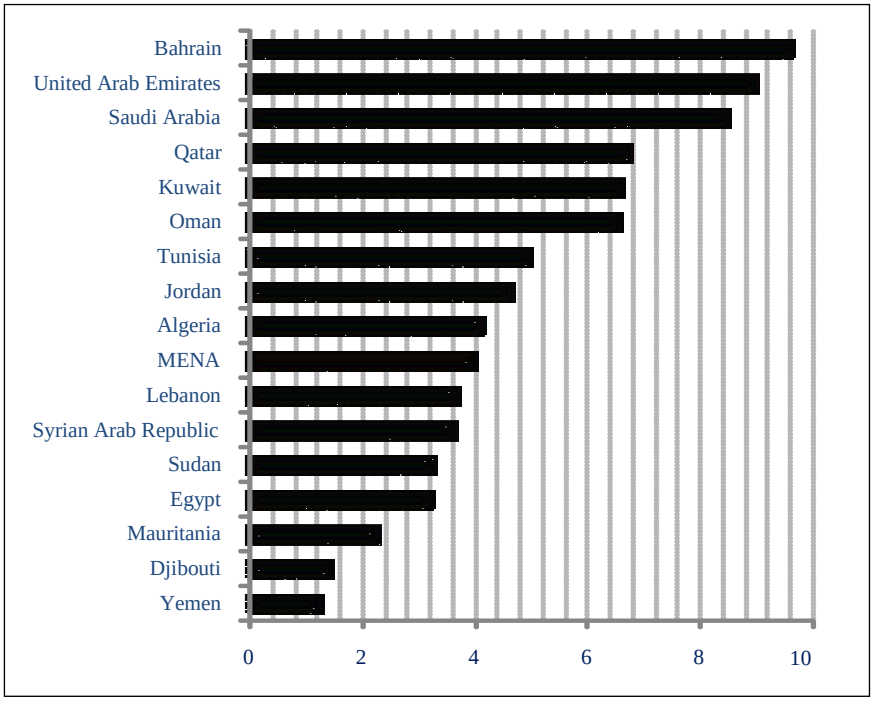
A. STATUS AND CHARACTERISTICS OF THE ICT SECTOR IN THE ARAB REGION

1. *Performance of the ICT sector*

The ICT sector in the Arab region has progressed in the past decade. Important efforts have been exerted both towards the greater use of information and technology goods and services, and also towards the development of this sector and its ability to produce ICT goods and services. Generally, Arab countries have made significant progress with regard to ICT uptake. Mobile-cellular subscriptions in the region increased three-fold in five years, rising from $126 million in 2006 to nearly $350 million in 2011; and mobile-cellular penetration reached 97 per cent, 9 per cent higher than the world average.[8] However, Internet usage, particularly broadband Internet access, remains limited: less than 30 per cent of the population in the region were online at the end of 2011 and fixed broadband penetration stood at just above 2 per cent. These figures are well below the world average of around 9 per cent.

Overall, the Arab region is still characterized by a relatively weak performance in the ICT sector. There are also disparities between countries in the region, with some countries performing far better than others.

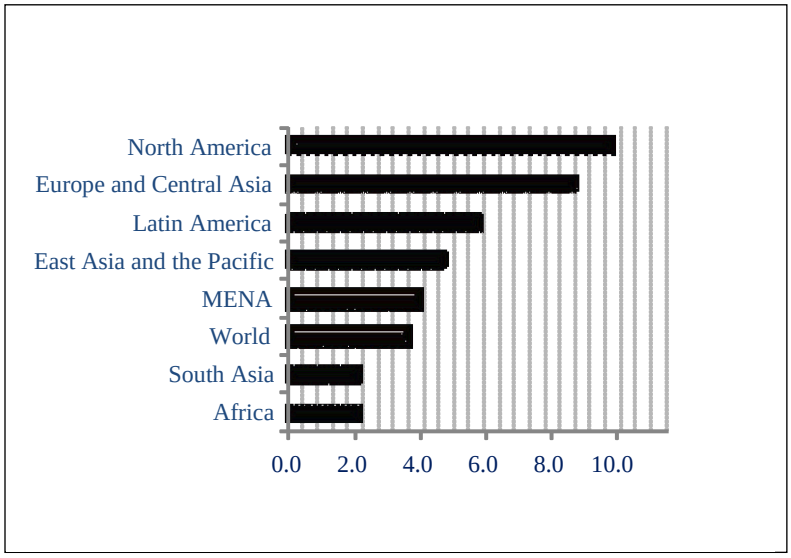
Figure 2. ICT subindex in the Knowledge Economy Index of the World Bank, 2012



Source: http://info.worldbank.org/etools/kam2/KAM_page5.asp.

[8] ITU, 2012a.

Figure 3. ICT sub index by region, 2012



Source: http://info.worldbank.org/etools/kam2/KAM_page5.asp.

Figures 2 and 3 illustrate the disparities in the performance of the ICT sector between the countries of the Arab region and between the Middle East and North Africa (MENA) region and the rest of the world. The MENA region, as a whole, ranks slightly above the global average in the ICT sub index of the World Bank's Knowledge Economy Index, which reflects the performance of the ICT sector with regard to ICT infrastructure and uptake. Within the MENA region, GCC countries are ranked significantly higher than the region's overall average.

Using the ICT Price Basket (IPB), which keeps track of the cost and affordability of ICT services, as another measure, the performance of the Arab region is discernibly uneven.[9] The large disparities in IPB values between those of the Arab region and global rankings reflect the region's diversity in terms of income and development levels, with ICT services being more affordable in high-income economies. By and large, an analysis of the fixed-telephony, mobile-cellular-telephony and fixed-broadband Internet figures suggests that prices in the Arab region as a whole are relatively expensive.[10]

2. *ICT spending*

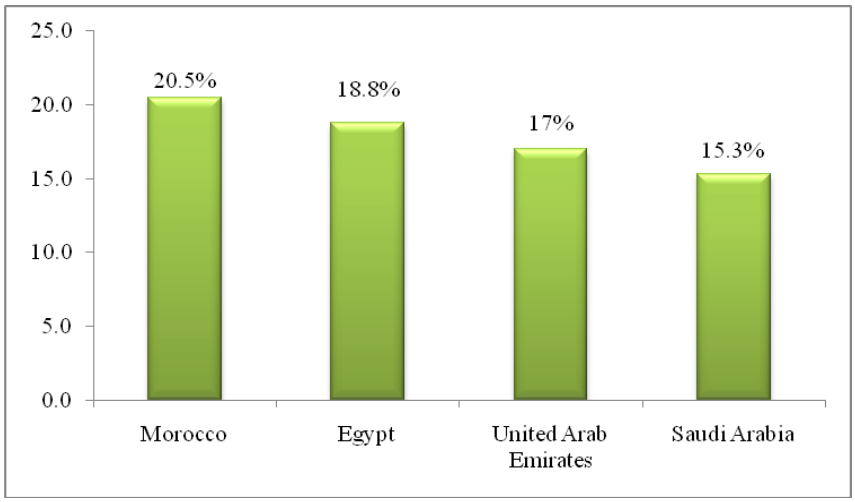
With regard to ICT spending, an indicator of the growth of the ICT sector, it is estimated that total worldwide spending amounted to $4,406 billion in 2012, of which 58 per cent was spent on communications services and equipment, 21 per cent on computer services, 12 per cent on computer hardware, and 9 per cent on software.[11] The Middle East registered a higher rate of ICT spending than the global average; the annual average increase of ICT spending in the region during the period 2010-2012 was about 10 per cent, compared to about 8 per cent for the world. It is notable that this regional growth has resulted mainly from relatively high growth rates in four countries in the region, namely Morocco, Egypt, Saudi Arabia and the United Arab Emirates, which ranked among the top 20 countries worldwide that registered the fastest compound annual growth rates over the past decade (figure 4).

[9] The IPB is composed of three distinct prices for fixed-telephone, mobile-cellular and fixed-broadband services. See ITU. ICT Price Basket (IPB). Available from http://www.itu.int/ITU-D/ict/ipb/.

[10] ITU, 2012a, p. 20.

[11] OECD, 2012, p. 55.

Figure 4. ICT spending growth, 2003-2012
(compound annual growth rate)



Source: OECD, 2012.

Box 1. Spending on ICT in GCC countries

Spending on ICT in the countries of the Gulf Cooperation Council (GCC) has been growing at a healthy rate and is likely to reach nearly $180 billion over the next three years. ICT spending in the subregion is expected to grow by 8-10 per cent driven by Saudi Arabia and the United Arab Emirates, which account for 50 per cent and 25 per cent, respectively, of total ICT spending in the GCC subregion.

In Saudi Arabia, ICT spending grew by 17 per cent year-on-year in 2008 to $24 billion, over 75 per cent of which was for communication spending. Of the nearly $90 billion expected to be spent on ICT infrastructure by 2012, $22 billion is likely to be spent on information technology and $67 billion on telecommunications.

In the United Arab Emirates, which represents the second biggest market, spending on ICT infrastructure has grown at a compound annual growth rate (CAGR) of 18 per cent over the past five years to nearly $12 billion, about 75 per cent of which was on communications. The growth is expected to moderate over the next three years, with a CAGR of 10 per cent to $16.5 billion by 2012. In 2008, ICT spending grew 23 per cent before decelerating sharply to an estimated annual growth of 5 per cent in 2009.

The majority of ICT spending in the United Arab Emirates is on the consumer segment, at about 50 per cent, while some 7-8 per cent is spent on each of the energy and utilities, government and services sectors. Spending on ICT, at 18 per cent, which includes capital expenditure on hardware and software, has been led by the expansion in the industry. Over the next three years, ICT spending is expected to grow more moderately, by 10 per cent, to a total of $45.8 billion. The majority of the spending, $36.4 billion, is expected to go to communications, while the remainder is for the ICT segment.

In Kuwait, around $16.5 billion is likely to be spent on ICT infrastructure over the next three years. More than $12.7 billion is expected to be spent on the communications segment.

Bahrain is expected to spend $5 billion on ICT infrastructure over the next three years.

Source: Kapur, 2010.

3. *Economic impact of ICT*

With regard to the impact of ICT on Arab economies, an assessment can only be as good as the tools and mechanisms globally available to measure the impact of ICT activities on overall economic performance. In this regard, a host of challenges have been identified by the international community stemming from conceptual, methodological and statistical issues, thereby rendering difficult any assessment.

The economic impact of ICT on various applications is not homogenous. For instance, the impact of ICT on e-government, e-business, e-education or e-health suffers from conceptual difficulties and may not be easily observed or assessed. In addition, the macro impact (i.e. poverty reduction, growth and/or employment) may require different methodologies and data requirements of the impact at the micro level (i.e. firms and industry's performance). These challenges are more obvious in developing countries, including the Arab region, given that these countries generally have fewer technical capabilities to gather data on the required economic and ICT indicators than advanced economies.

Barring these challenges, the positive impact of ICT has not been contested. For instance, in a review of research on the macroeconomic impact of ICT, the United Nations Conference on Trade and Development (UNCTAD) reports evidence of productivity gains in developing countries and that the development of a strong ICT sector has generally shown a positive link with GDP growth and poverty reduction.[12] At the micro or firm level in developed countries, it is acknowledged that while the regular use of computers, the affordability of broadband and easy access to the Internet have positive impacts on productivity, the level of these impacts is closely linked to the development of specific skills and the encouragement of innovation within a firm.

Knowledge and innovation have become main drivers of economic growth. According to the new growth theory, knowledge, technology and innovation have been assuming greater importance in explaining growth through increases in total factor productivity (TFP) and human capital. Over the past decade, the MENA region witnessed an acceleration of growth explained partly by productivity gains. In particular, TFP gains were achieved in Egypt, Jordan, Libya, Morocco and Tunisia.

In Saudi Arabia, according to estimates by the Communication and Information Technology Commission (CITC), the contribution of the ICT sector to national GDP was an estimated 3 per cent in 2011 and has been rising over the past three years.[13] In Qatar, the Government seeks to create a competitive knowledge-based economy through a broad five-year national ICT plan aimed at doubling the ICT workforce and the ICT sector's contribution to GDP. In total, the Government of Qatar is set to invest more than $1.7 billion to advance this digital agenda by 2015.[14]

The broader and more efficient use of ICT is believed by many to be a major driving force in modern economies, given that it facilitates broader transmission of knowledge, higher TFP and advancement in establishing knowledge-based economies. This, in turn, is an enabling factor to move closer towards the adoption of national and regional policies aimed at nurturing and supporting the ICT sector and boosting its contribution to national output. On this front as well, the Arab region must exert concerted efforts to prepare this sector not only to increase its added value in GDP, but also to increase the productivity of other economic sectors. It is within this context that the contribution of the ICT sector to economic progress in the Arab region is assessed, in addition to highlighting the policies and strategies to promote investment and innovation in this sector.

[12] UNCTAD, 2011, pp. 10-11.

[13] CITC, 2011, p. 21.

[14] ictQatar, 2013, p. 1.

B. EXISTING ICT POLICIES AND STRATEGIES AND THEIR IMPLEMENTATION IN THE REGION

In the early 2000s, several countries in the Arab region adopted ICT-related strategies and began setting the stage for the launch of this sector. Oman announced its Digital Government Strategy in 2003, followed in 2004 by the Syrian Arab Republic with the ICT Strategy for Economic and Social Development, and Palestine with the National ICT Strategy. Others followed suit, in line with WSIS recommendations, with Yemen being the most recent country in the region to implement a strategy, namely the Information Technology Master Plan for Yemen, adopted in early 2011. Iraq is the only Arab country that has not finalized and adopted an ICT strategy to date. However, while the pace of implementation of ICT strategies has been excellent in a number of countries, particularly in Bahrain, Qatar and the United Arab Emirates, limited achievements have been made in others, such as Lebanon and Palestine.[15]

In addition to national ICT strategies, sectoral e-strategies have been developed by some countries in the region. The International Telecommunication Union (ITU) notes that e-government strategies are the most common type of sectoral e-strategies.[16] Nevertheless, national e-strategies in the region have developed in the past few years where increasingly more sectors are being involved and more sectoral e-strategies are being pursued, including e-education and e-health sectoral strategies.

For instance, Abu Dhabi's e-Government Strategy has two major targets, namely, "to develop a world class customer experience for users of Government services, and to drive Government modernisation by positioning the Abu Dhabi Government as a customer-focused service provider".[17] Equally in the United Arab Emirates, Dubai seeks to become a leading ICT services outsourcing centre that goes well beyond the simple provision of helpdesk support for companies in order to encompass IT operations and infrastructure management, server consolidation and Internet services.

Other countries, including Egypt, have broadened the policy scope and revised their ICT strategies to go beyond the local dimension and to seek a regional and international role as stated in the Technology Innovation and Entrepreneurship Strategy 2011-2014. The Ministry of Communication and Information Technology maintains that Egypt is prepared to move to the next level in order to enhance its global competitiveness position and become the primary regional hub for innovation by 2020.[18]

Furthermore, other countries have revised their policies seeking a greater level of local capacity-building, as opposed to simply attracting FDI and transnational corporations. A case in point is Dubai's drive to encourage startups as a source of growth and national income. Within that context, Dubai Internet City (DIC) aims "to focus on nurturing and attracting local startups for future growth instead of multinational companies; to sustain an ICT ecosystem, DIC is in need of startups and small entrepreneurs".[19]

In Jordan, efforts to devise a comprehensive framework and strategy for the country's ICT sector started in 1999, resulting in the REACH Initiative (1999-2005), which aimed to create a competitive ICT sector and which included the development of a regulatory framework. Learning from this first experience, Jordan followed in 2007 with the National ICT Strategy, which aimed to achieve the following three objectives before the end of 2011: (1) increasing Internet penetration to 50 per cent (it was at 11 per cent in 2007); (2) raising the number of ICT workers from 16,000 to 35,000; and (3) tripling the ICT sector's

[15] ESCWA, 2011, p. 4.

[16] ITU, 2010, p. 17.

[17] Abu Dhabi, Government Services Transformation. Available from http://adsic.abudhabi.ae/Sites/ADSIC/Navigation/EN/eGovernmentStrategy/government-services-transformation.html.

[18] Egypt, Ministry of Communication and Information Technology, 2011, p. 2.

[19] Dubai Internet City, 2012.

revenue to $3 billion. The Strategy also focused on eliminating regulatory challenges to business and advocating the interest of ICT companies to ensure continued sector growth. In order to support the ICT sector, the Government sought to relax investment requirements, enhance ICT education, and pass legislation to protect intellectual property rights (IPRs).[20]

As part of their strategies to enhance the status of the ICT sector, most countries in the region have established separate regulatory authorities to organize and regulate this sector. The only countries that have not established such entities are Kuwait, the Syrian Arab Republic and Yemen. In these countries the ministries of communications and information assume the role of regulators.

Overall, according to ITU, the regulatory framework of key telecommunication services in Arab countries demonstrates that there are important differences between countries in terms of the liberalization of services, as well as in the number of service providers operating each service. Furthermore, ITU notes that the most liberalized ICT services in the region are the mobile-cellular markets, while Comoros and Djibouti remain the only two countries with only one national mobile-cellular operator.[21]

C. Priorities of the ICT sector in the Arab region

As stressed above, the development of the ICT sector is not a goal by itself, but rather a means and a contributor to the overall socioeconomic development process. Consequently, there is a need to identify the appropriate priorities of this sector. The success of the policies and strategies to develop the ICT sector as well as enhance its contributions to achieving developmental goals rests on adopting applicable national and region-specific programmes and setting both long- and short-term priorities.

In the Arab region, ICT priorities need to mirror the developmental needs of the region and of its constituent countries, both in the immediate and the long term. The Arab region is saddled with a number of social and economic challenges in need of effective remedies. For example, the World Bank highlights the need of the region to reorient education output to create a better match between workers' skills and private-sector needs.[22] Specifically, education systems in the region are generally skewed towards humanities and social sciences at the expense of technical, scientific and business training, which are the areas that matter most for innovation and knowledge creation.

Keeping the above in mind, the priorities of the ICT sector in the Arab region can be classified under the following categories:

(a) Enhancing the competitive advantage of the ICT sector to help access new markets and promote exports;

(b) Advancing the social dimensions of the Millennium Development Goals (MDGs) as well as other social development dimensions, including free and open democratic governance;

(c) Creating job opportunities in a region where unemployment rates are considered excessive.

Many Arab countries have outlined their ICT priorities as part of their strategies for the ICT sector. For instance, in Morocco, Maroc Numeric 2013 has been developed as part of the Government's National Strategy for Information Society and Digital Economy.[23] The programme is based on four strategic priorities,

[20] Information and Communications Technology Association Jordan. ICT Sector Classification and Statistics 2011/2012. Available from http://www.intaj.net/node/64.

[21] ITU, 2012a, p. 3.

[22] World Bank, 2012a, p. 89.

[23] Morocco, Ministry of Industry, Commerce and New Technologies. National Strategy for Information Society and Digital Economy. Available from http://www.egov.ma/Documents/Maroc%20Numeric%202013.pdf.

namely: (a) providing citizens with high-speed Internet; (b) connecting users and government agencies; (c) encouraging the computerization of small and medium enterprises (SMEs); and (d) developing national digital content.[24] This Strategy aims to contribute towards the development of the ICT sector itself, making it more accessible to users and to other sectors, and to boost the overall development process.

According to the Ministry of Information and Communications Technology in Jordan, the top priority for the information technology sector is a reliable supply of human resources. The Ministry has identified a number of major national cyber security priorities, which collectively contribute to achieving the strategic objectives; protect national infrastructure against damage or attacks; and minimize damage and recovery time from attacks.[25] Other identified priorities are as follows: (a) risk management; (b) legal and regulatory framework; (c) national encryption; (d) security awareness; (e) capacity-building; (f) information security standards and policies; and (g) national infrastructure protection.

[24] ITU, 2012a, p. 86.

[25] Ibid., p. 60.

III. COMPETITIVENESS OF THE ICT SECTOR

A. CONTRIBUTION OF ICT TO THE KNOWLEDGE ECONOMY AND TO ECONOMIC GROWTH

To a greater or lesser degree, ICT provides the backbone, tangible and intangible infrastructure, applications, services and content at the heart of a knowledge economy. As such, it is one of the founding pillars of knowledge economies together with innovation, education and the quality of institutions. Its interaction with the above-mentioned pillars and its contribution to the knowledge economy and to economic growth are discussed in the sections below and, in the case of innovation, in chapter IV.

1. *ICT and productivity*

With regard to the contribution of ICT to such macroeconomic variables as productivity and growth, the issue has been controversial for several years, especially since the first studies in the 1980s revealed the existence of the so-called "productivity paradox" – that is, the absence of an apparent connection between ICT investment and productivity at the level of firms, industries or the economy as a whole.[26] Subsequent studies, however, have revealed that several components of the ICT ecosystem, starting with the infrastructure layer, are key enablers of the knowledge economy as well as of productivity and growth. A number of studies have shed light on the relationship between investments in ICT and growth.[27]

ICT can contribute positively to economic growth through four major channels, namely:[28]

(a) Production of ICT goods and services, which directly contributes to the aggregate added value generated in an economy;

(b) Increase in productivity in the ICT sector, which contributes to overall productivity in an economy;

(c) Use of ICT capital as input in the production of other goods and services;

(d) Contribution to economy-wide TFP from increase in productivity in non-ICT producing sectors induced by the production and use of ICT (spillover effects).

The last two effects seem to be of increasing magnitude in several economies worldwide. Since the mid-1990s, it has been clear that the main explanatory variable in the difference in productivity (often termed the "productivity gap") between the United States and the European Union (EU) was indeed ICT. Kretschmer (2012) reports consistent evidence of a very significant impact of ICT on productivity growth, to the point that consensus seems to be emerging on the "general purpose" nature of ICT.

Available literature distinguishes between ICT production and ICT adoption. Iammarino and Jona-Lasinio conclude that "more than mutually exclusive categories, ICT production and ICT adoption should be seen as complementary forces influencing productivity" and that "the degree of interdependence and relatedness of knowledge generation and diffusion, and of competences and capabilities across industrial and technological structures, are all critical factors underlying productivity trends".[29]

UNCTAD also provided a useful scheme to understand how ICT can permeate the whole economy and serve as an "enabling" or "general purpose" technology. First, ICT "increases the efficiency of factor

[26] Strassman, 1990; Roach, 1991; and Loveman, 1994.

[27] Oliner and Sichel, 2001 and 2002; and Jorgenson and Stiroh, 1995, 1999 and 2000.

[28] The wording of these four channels is based on Pohjola, 2003; and Guerrieri and Padoan, 2007.

[29] Iammarino and Lasinio, 2013.

inputs (capital and labour) and, second, it fosters technological innovation as a source of total factor productivity growth. Labour productivity in particular grows as a result of capital deepening through incorporating ICT capital inputs into the production process. In this case, ICT investment results in improved labour efficiency without changing the technology of production. When, in addition to capital deepening, economic agents are able to relocate resources in a way that improves technological efficiency and better incorporates ICTs into their production processes, ICT use can result in total factor productivity gains".[30]

2. *ICT and growth*

Economic growth in Western Europe and the United States during the late eighteenth and early nineteenth centuries can be attributed to the Industrial Revolution. Two hundred years later, the invention of the microprocessor, the propagation of personal computers, the globalization of the Internet and the democratization of mobile technologies have all helped to usher in a new age which is known by different monikers, including the information age, the digital revolution or the ICT revolution. ICT, being the main engine of this revolution, is widely credited with having a positive impact on economic growth.

In 2009, ICT contributed $1 trillion to the United States economy, which is equivalent to 7.1 per cent of GDP. This comprised $600 billion as direct contributions of the ICT sector to the economy, while the remaining $400 billion was generated by other sectors that rely on ICT.[31] The National Research Council found that the ICT industry accounted for 25 per cent of economic growth in the United States from 1995 to 2007 measured as real change in GDP. Over the past two decades, the development and use of ICT has accounted for as high as 60 per cent of annual labour productivity gains.

During the same year, the ICT sector in the European Union represented roughly 4 per cent of GDP, a share that has remained stable over the past several years.[32] The ICT sector employs 6.1 million people, representing 2.7 per cent of total employment in the Union. With a ratio of 5.3 per cent, the R&D intensity of the ICT sector was more than four times the average R&D ratio of 1.2 per cent. A recent study by Oxford Economics estimated that, by 2020, if Europe was able to increase its ICT capital stock to the same level (relative to the size of the economy) as that of the United States, the result would be impressive: GDP would increase by an average of 5 per cent – equivalent to about 760 billion euros for the European Union as a whole, or 1,500 euros per person.[33]

For China, it is estimated that, by 2020, the ICT sector will account for 7.2 per cent of the economy, contributing 8.6 per cent of economic growth over the current decade.[34] Spiezia concluded that ICT producing industries accounted for no less than two-thirds of TFP growth in Germany, Slovenia and the United Kingdom; about 60 per cent in the United States; and just below 50 per cent in France and the Netherlands. In Denmark, the Czech Republic and Italy, TFP increased in the ICT-producing industries whereas it decreased for the total business sector.[35]

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[30] UNCTAD, 2007, p. 154.

[31] Andersen and Coffey, 2011.

[32] European Commission, Joint Research Centre, Institute for Prospective Technological Studies. Size of the ICT sector (value-added) by ICT sub-sectors. Available from http://is.jrc.ec.europa.eu/pages/ISG/PREDICT/2da/1a.html.

[33] Oxford Economics, 2012.

[34] ITU, 2011, p. 6.

[35] Spiezia, 2012.

Box 2. ICT and gender

The use of ICT is increasingly linked to the goal of empowering women and attaining more gender equality. A recent study found that, across the developing world, "on average, nearly 25 per cent fewer women and girls are online than men and boys, and this gender gap increases to above 40 per cent in regions like sub-Saharan Africa".[a/] In addition, while mobile phone ownership is widespread throughout the world, in low- to middle-income countries about 300 million more men than women own mobile devices.[b/] A woman is 21 per cent less likely to own a mobile phone than a man in these countries. The European Commission reported recently that out of the ICT workforce, only 30 per cent were women and that women were under-represented at all levels in the ICT sector, especially in decision-making positions. This is one of the causes of the lack of 700,000 skilled ICT workers needed in Europe by 2015, according to estimates by the European Commission.

Against this background, the development of ICT provides a win-win situation for Governments and women. On the one hand, by empowering women in ICT, Governments can more easily close the skills gap and achieve the level of penetration needed to take full advantage of e-government and e-health services. On the other, women can achieve a superior level of social participation in all countries, given that their current levels of participation are significantly lower than those of men both inside and outside the ICT sector, in the vast majority of countries across the world. One notable example of an initiative that was launched to boost the use of ICT, specifically mobile services, by women is the Business Women service launched by Nokia in cooperation with the Exxon Mobile foundation, the Cherie Blair Foundation and MTN Nigeria. This initiative aims at providing essential business tips to women entrepreneurs throughout Nigeria via mobile phone technology.

Source: a/ Intel, 2013.
b/ Cherie Blair Foundation for Women and GSMA Development Fund, 2010.

B. CHALLENGES TO THE DEVELOPMENT OF A COMPETITIVE ICT SECTOR

The challenges impeding the development of a competitive ICT sector in the Arab region include barriers introduced by public as well as private sector enablers. The challenges are not unique to the Arab region and may be found in many developing economies. The barriers may be categorized under the following main themes:

(a) Lack of government incentive programmes;
(b) Ineffective, non-existent or restrictive regulatory environments;
(c) Inadequate ICT infrastructure;
(d) Finance requirements and mechanisms;
(e) Economic constraints.

1. *Lack of government incentive programmes*

It is generally agreed that some major enablers of promoting innovation and investment in the ICT sector fall within the purview of Government, which is entrusted with the task of establishing the suitable legal, regulatory and overall economic policy frameworks needed to encourage private sector activity and put in place a level playing field that allows ICT to flourish and compete freely. In the absence of this effort by the State, challenges to ICT development mount and, therefore, specialized government agencies need to carry out the following:

(a) Enhance legal frameworks, and investment and commercial laws. Unfavourable legal frameworks and investment laws stymie innovation and discourage investment, in particular foreign direct investment (FDI) which brings with it technical know-how and advanced technology. Research as well as anecdotal evidence presents ample cases in this respect;

(b) Protect IPRs. The absence of IPR protection in some emerging markets and developing countries is resulting in dampened entrepreneurial spirit and low levels of innovation and R&D spending. Poor IPRs and patenting environments can become major obstacles to the development of ICT, and firms are only

encouraged to pursue such activity under supportive and favourable conditions. The World Intellectual Property Organization (WIPO) considers that this is what motivates a firm to build up proactively large patent portfolios to ensure its freedom to innovate and strengthen its competitiveness;[36]

(c) Ensure enforcement of contracts, which is essential to attracting FDI and foreign venture capital, as well as domestic angel capital funds and local investment. Poor and lengthy procedures for enforcing court ruling and legal proceedings are major challenges facing emerging and less developed countries. Nigeria is a case in point, in that the country is seeking to attract ICT investments and become an off-shore hub in Africa in order to diversify its sources of income and production base. Yet, despite progress relative to other countries in Africa, it still faces a number of challenges, including the fact that a contract still takes more than a year to be enforced and costs 27 per cent of the claim;[37]

(d) Provide adequate ICT infrastructure, which is widely agreed to form the backbone of ICT promotion and competitiveness. The lack of an ICT infrastructure naturally deprives a nation of the basic requisites of a knowledge-based economy;

(e) Enhance labour laws, particularly given that constantly changing labour laws and restrictive labour rules represent an impediment to a country's ability to attract investment and promote innovation in the ICT sector. This is especially the case in countries where there are insufficient numbers of skilled technical labour, technicians and researchers to fill the needed posts in laboratories, universities and firms providing ICT goods and services. In the MENA region, for instance, labour market challenges are substantial in all aspects of the development process, including providing the ICT sector with much needed skills. It is argued that labour market mismatches in the region have been driven by both the inability of the economy to create highly skilled workers and by the inappropriate content and delivery of education. In addition, it is argued that labour regulation, as a major constraint to business operations, is highest on average in the MENA region.[38]

2. *Ineffective, non-existent or restrictive regulatory environments*

It is widely reported that the "implementation of an effective regulatory framework has resulted in greater economic growth, increased investment, lower prices, better quality of service, higher penetration, and more rapid technological innovation in the ICT sector".[39]

In this context, experience has shown that one major impeding challenge to speeding up the ICT drive and improving innovation and investment climates is that emerging and developing markets have not accelerated the slow pace at which regulatory authorities are established. Establishing industry regulators is expected to unleash competitive forces, and concurrently put in place proper rules to ensure the quality and affordability of goods and services to users as well as developers and providers of ICT.

The Task Force on Financial Mechanisms for ICT for Development (TFFM), which was commissioned by the United Nations, identified the following key regulations as being necessary for the promotion of market-based development:[40]

(a) Licensing procedures;
(b) Competition regulation;
(c) Interconnection regulation;
(d) Reducing costs and risks.

[36] WIPO, 2011, p. 11.

[37] Radwan and Strychacz, 2010, p. 5.

[38] Masood, 2012.

[39] ITU, 2006, p. 4.

[40] UNCTAD, 2010, p. 2

In this regard, a level playing field among state-owned enterprises, government units and private sector enterprises must be in place, with no preferential treatment given to state-owned enterprises and government operators at the expense of private sector operators, such as export subsidies and cheaper finance. Any such programmes, if available and allowed, must treat all enterprises equally.

Furthermore, it is central that the introduction of regulatory authorities to oversee competitive markets and the provision of ICT goods and services must precede liberalizing markets in order to avert policy reversals and setbacks in the process of developing the ICT sector. In this context, the Economic Commission for Europe suggested that in the telecommunications sector, the establishment of an independent regulator to oversee its competitive liberalization could be a key driver of electronic commerce. However, ECE saw that the challenge for effective regulatory institutions was the task of acquiring adequate expertise and resources, which developing countries could find difficult to support.[41] This point of view has been echoed more recently by UNCTAD, which argued that the "challenges associated with market liberalization include not only the basic steps of modifying legislation and issuing new licenses, but the more complex demands of developing regulations".[42]

While many developing countries lack the needed regulatory frameworks, some developed countries have restrictive ones, with both systems posing challenges and constraints to innovation and investment in the ICT sector in various markets. For example, restrictive labour regulations aimed at protecting employment in developed European countries hinder ICT productivity, given that they can discourage enterprises from replacing unskilled workers with those possessing higher ICT skills.[43]

Equally important to the need for establishing an adequate regulatory framework is the keenness of Governments to relax regulations once a competitive environment has been established and all operators have a level playing field and are held at arms' length.

3. *Inadequate ICT infrastructure*

The lack of an adequate ICT infrastructure has been a major impediment to the successful advance towards a knowledge-based economy where information and communication goods and services contribute significantly to the workings of other sectors in the economy through better and more efficient allocation of resources, thereby creating synergy and adding value to social and economic activities.

For instance, the International Institute for Sustainable Development (IISD) holds that despite the fact that growth in broadband capacity is accelerating in developing countries, there is a growing gap in broadband provision between industrial countries with very rapid investment and poorer developing countries where investment is not as forthcoming.[44] Some consider that the presence of such a gap owes to one of the barriers most frequently raised and discussed in this regard, namely, affordable access in developing countries to the physical infrastructure of e-commerce.[45]

Moreover, UNCTAD reveals that a main barrier to the faster development of ICT in the developing world is the lack of affordable transmission capacity in backbone networks.[46] It is worth stressing, in this respect, the importance of the affordability dimension of broadband penetration. The high cost of civil works for fibre deployment, for example, discourages mass investment in fixed-line broadband outside

[41] ECE, 2007, p. 3.

[42] UNCTAD, 2010, p. 2.

[43] European Commission, 2010, p. 12.

[44] Souter, 2012, p. 5.

[45] Wunsch-Vincent, 2004, p. 28.

[46] UNCTAD, 2010, p. 8.

densely populated areas. At the same time, competition policy should ensure that an efficient balance is kept between price-reducing competition (for example, through access policy) and investment-enhancing policy (such as access holidays for broadband investment). Alternatively, where funds are available, demand-side or supply-side subsidies or public-private partnerships could be used to reduce the cost exposure of the private sector in undertaking investments that will, ultimately, generate positive externalities for society as a whole. In most cases, a key task for the policymaker is indeed to solve the trade-off between availability and affordability.

Important as it is, the lack of infrastructure, or access to it, is not limited to physical infrastructure. It includes human capital, which represents a major tributary to the use of and innovation in the ICT sector. Consequently, the inputs and outputs in the education system, manifested by the availability of a pool of skilled human resources are essential. The lack of such an important ICT enabler is a main challenge in this sector. This is of particular concern in emerging and developing economies.

For example, the United Nations Department of Economic and Social Affairs (DESA) highlights the challenges facing countries everywhere in implementing ICT in their education systems, contending that many local, national and regional government bodies are still not giving this issue the attention it deserves.[47] DESA also cites financial constraints as another major obstacle for developing countries.[48]

Nevertheless, it is not only emerging and developing countries that face challenges in this respect. The European Commission laments the growing deficit of qualified workers with skills in ICT research and development in the European Union, resulting in hundreds of thousands of unfilled posts, adding that Europe has relatively few world-recognized ICT poles of excellence. This affects the attractiveness of Europe to students and researchers.[49]

This challenge is paramount in Brazil, one of the main emerging markets, where qualified labour scarcity in the ICT sector points to the largest deficit of professionals in its history. It is estimated that unfilled ICT sector vacancies will reach nearly 200,000 by 2013.[50]

In Africa, it is claimed that the most prevalent challenges across the continent to move fully forward in the high-tech business areas are infrastructure, energy constraints and the ICT skills gap.[51]

4. *Finance requirements and mechanisms*

Resource mobilization is a major factor that could impede the development and competitiveness of ICT. Insufficient resources and/or inefficient allocation of available resources have a perverse effect on the ability of this sector to reach its potential and contribute to other sectors in the economy.

It is this recognition that prompted TFFM to pay this issue greater attention. The Task Force highlighted this challenge for ICT development, noting that while traditionally in developing countries the financing of ICT infrastructure came either from government budgets or from international donors and financing institutions, there had been a recent shift towards a greater reliance on private capital.[52]

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[47] DESA, 2009, p. 3.

[48] Ibid., p. 8.

[49] European Commission, 2009, p. 4.

[50] IT Decisions, 2012.

[51] eTransform Africa, 2012, p. 9.

[52] WSIS, 2005, p. 3.

Financing requirements and the cost of such activity, especially in the provision of ICT basic infrastructure, is a major challenge in this area. It is very telling when UNCTAD reveals that the barriers to more rapid development of ICT in developing countries is the lack of affordable transmission capacity in backbone networks, since these networks invariably require the highest upfront investment in major infrastructure.[53]

The finance challenge is not limited to developing countries and emerging economies. It is an equally important issue in developed countries. For instance, one major challenge in Europe is underinvestment in ICT research, development and innovation noting that the State of California in the United States alone attracts twice as much venture capital as the whole of Europe.[54]

The innovation drive in Europe is reported to be less than that of the United States, owing primarily to financial considerations. European firms are comparatively less present as leading innovators in new ICT sectors because of the greater willingness of financial markets in the United States to fund projects in new sectors. In addition, the lower exit and re-entry costs for firms and the greater mobility in the United States labour market facilitate the emergence of new industries and new firms in that country.[55]

5. *Economic constraints*

Economic constraints impair the process of elevating the ICT sector to a more advanced stage and fostering its competitiveness, and represents a country's inability to garner the needed financial backing to undertake massive costly projects in the area of ICT. The acquisition of costly high-technology components, such as hardware, software and knowledge, is not only a challenge to the abilities of Governments and private sectors to support their plans to develop the ICT sector; low-income countries also face a problem of demand of ICT goods and services, especially in rural areas and among the poor segments of their societies, thereby weakening the demand side for such products and markets.

In this respect, the World Bank holds that despite the efforts of mobile phone companies in most countries to upgrade their networks to offer broadband wireless data, gaps in access remain for the rural poor.[56] These gaps originate from both low coverage in rural areas and the inability of the poor to afford the services. The World Bank reports that, globally, while broadband connections number around 1.5 billion, most are in the developed world. Broadband access in poor areas remains limited and unaffordable. In this regard, studies show that addressing direct cost challenges, in particular reducing the cost of access for mobile and broadband, will require improving the regulatory and competitive environments for operators as well as better coordination in developing the infrastructure.[57]

C. COMPETITIVENESS OF THE ICT SECTOR: KEY FACTORS AND MECHANISMS

Over the past few years, economists have widely discussed the potential factors that determine the competitiveness of national ICT sectors. The underlying rationale is that, since ICT is found to be a major driver of productivity and growth, understanding the factors that boost ICT competitiveness can automatically translate into key policy measures that would lead to competitiveness and growth. The most widely acknowledged determinants of a competitive ICT environment include infrastructure, education, institutional quality, innovation and investment. The first three are explained in the sections below. The last two, namely innovation and investment, being the imperatives of this study, are covered in chapters IV and V, respectively.

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[53] UNCTAD, 2010, p. 8.

[54] European Commission, 2009, p. 4.

[55] European Commission, 2012a, p. 12.

[56] World Bank, 2012b, p. 22.

[57] eTransform Africa, 2012, p. 19.

1. *Infrastructure*

While ICT in and of itself provides an infrastructure for applications and services, the ICT ecosystem requires the presence of a solid, resilient and affordable high-speed broadband infrastructure. This in turn requires a resilient electricity network and/or the allocation of a spectrum for emerging, high-speed mobile broadband, especially in areas that are less densely populated. Recent research has shown the following:

(a) Broadband expansion and economic growth are linked. This link becomes more evident in industries that rely more on information technology as well as in more sparsely populated regions;[58]

(b) Doubling the broadband speed for an economy increases GDP by 0.3 per cent;[59]

(c) Broadband exhibits a higher contribution to economic growth in countries that have a higher adoption of the technology;[60]

(d) Broadband has a stronger productivity impact in sectors with high transaction costs, such as financial services, or high labour intensity, such as tourism and lodging;

(e) In less developed regions, as postulated in economic theory, broadband enables the adoption of more efficient business processes and leads to capital-labour substitution and, therefore, loss of jobs (this could be labelled the "productivity shock theory");

(f) The impact of broadband on SMEs takes longer to materialize owing to the need to restructure corporate processes and labour organization in order to gain from adopting the technology (this is called "accumulation of intangible capital");

(g) The economic impact of broadband is more important when twinned with the promotion of pioneering businesses that offer innovative applications. This in turn implies that when it comes to broadband deployment, the innovation and investment imperatives are inextricably linked;

(h) Based on data for the period 1980-2002, an increase of 10 per cent in broadband penetration yielded an additional 1.21 per cent of GDP growth in high income countries, rising to 1.38 per cent in low- and middle-income countries.[61]

Even more importantly, broadband is an essential precondition for the ICT ecosystem to flourish. For example, in the United States the "app economy" was found to generate as many as 466,000 jobs in 2011. All emerging cloud applications require a resilient, ubiquitous fixed and/or mobile broadband infrastructure as does the shift towards e-government services. This is why such developing countries as Nigeria have prioritized broadband deployment as a precondition for speeding up growth in the coming years.

[58] Kolk, 2011.

[59] This estimate is by Ericsson, Arthur D. Little and Chalmers University of Technology from data from 33 OECD countries. The study quantifies the economic impact of increases in broadband speed in a comprehensive scientific method using publicly available data. The economic impact of average attained broadband speed, both fixed and mobile, has been analysed using panel data regression analysis with quarterly data points from 2008-2010 for 33 OECD countries. The data showing average achieved broadband speed was provided by Ookla. A GDP growth of 0.3 per cent (one-directional, isolated effect) in the OECD region is equivalent to $126 billion.

[60] This is sometimes referred to as the "critical mass" or "return to scale" theory. ITU, 2012b.

[61] Qiang and Rossotto, 2009.

2. *Education, skills and digital literacy*

Another fundamental driver of ICT uptake and competitiveness is education. The three most essential prerequisites of this driver are: (a) high-quality secondary and tertiary education systems; (b) widespread e-skills; and (c) digital literacy. These elements are explained in more details below:

(a) A high-quality secondary and tertiary education constitutes a fundamental ingredient of the so-called "knowledge triangle" that brings together education, research and industry. For example, when universities produce skilled graduates and high-quality ICT research, and the legal and business environment offers the chance to translate it into applied research and innovative products, the whole sector can profit from a more dynamic flow of ideas and cross-fertilization in innovation;

(b) Quality ICT education leads to the creation of a qualified workforce that has the e-skills in demand in developed and developing countries. A qualified workforce will include skilled entrepreneurs, skilled researchers and skilled employees. An example of the importance of this requirement can play out in the following scenario: a multinational ICT company might decide not to invest in data storage centres in a certain country owing to a shortage of skilled workers;

(c) Digital literacy among youth is an essential precondition for creating a population of "Yollies", the young and dynamic entrepreneurs who, through startup ventures, often contribute to a dynamic ICT environment.[62]

3. *Institutional quality*

International economic trends in recent decades have shown a positive correlation between the quality of institutions (as measures, including, for example, the World Bank's Worldwide Governance Indicators) and economic performance at the national level. This is true also for the ICT sector, especially when it comes to creating a legal environment that is conducive to innovation, and promoting investment in ICT infrastructure, applications and services.

Key issues in this respect include the following:

(a) A clear political vision of broadband and ICT development in the years to come, possibly developed within a national ICT strategy that is published and shared with all stakeholders;

(b) Regulatory reform aimed at facilitating the protection of inventions through patent policy, as well as technology and knowledge transfer to the benefit of local entrepreneurs;

(c) Reforms aimed at improving the enforcement of the rule of law, as well as facilitating entrepreneurship. These include, most notably, the simplification and streamlining of legislation for starting a new business, applying for licences where applicable, and reforms aimed at fighting corruption and reducing the size of the informal economy;

(d) Reforms of financial regulation and company law aimed at strengthening the venture capital and business angel market for startup businesses.

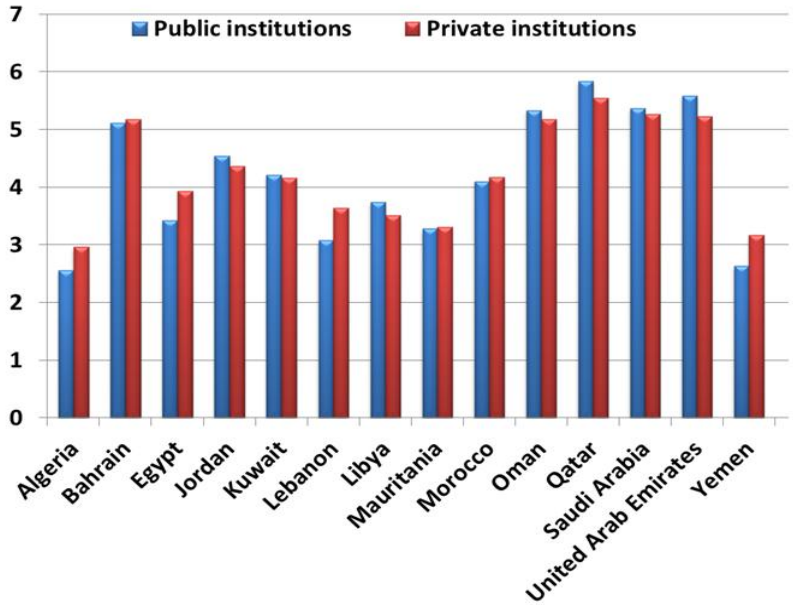
In 2012, the World Bank reported great progress in Morocco, which "launched a fully operational one-stop shop for obtaining construction permits, (…) eased the administrative burden of paying taxes for firms by enhancing electronic filing and payment of the corporate income tax and value added tax, (…) adopted a new law modifying the rules of procedure governing commercial proceedings".[63] In the recent Global

[62] Veugelers and Cincera, 2010.

[63] World Bank, 2012c.

Competitiveness Report of the World Economic Forum, Qatar is praised for "low levels of corruption and undue influence on government decisions, highly efficient government institutions, and high levels of security are the cornerstones of the country's very solid institutional framework. These institutional attributes provide good foundations for efficiency".[64] By contrast, the recent political turmoil in Egypt will lead to greater future competitiveness only if it comes through "investment in quality institutions, good governance, transparency, rule of law, improved domestic security, a much-streamlined bureaucracy, and drastically reduced corruption".[65]

Figure 5. Global Competitiveness Index: Public and private institutions in selected countries, 2011-2012



Source: WEF, 2013.

Figure 5 illustrates the ranking of selected Arab countries in the Global Competitiveness Index with regard to the quality of their public and private institutions. It highlights the very uneven quality of institutions between Arab countries, with Algeria and Yemen exhibiting the most apparent problems and GCC countries generally performing better than other countries in the Arab region.

[64] WEF, 2013.

[65] Ibid.

IV. INNOVATION IN THE ICT SECTOR

A. MAIN ACTORS OF INNOVATION

An innovation ecosystem requires the simultaneous existence of several actors, each with a different role to play. In academic literature, the concept of a national innovation system emerged in the 1980s and is normally referred to as "the set of public and private actors involved in the exploitation and commercialization of new knowledge originating from the science and technology base and the interactions between them".[66] This concept has been operationalized by several academics who developed indexes of national innovative capacity that rely heavily on the specific role played by each of the main actors that shape innovation patterns and success in a given country.[67] These actors are entrepreneurs, large businesses, SMEs, universities, research institutes, venture capitalists, business angels and Governments.

1. *Entrepreneurs*

Innovation in ICT requires creative entrepreneurs who have the capacity to generate, bring to market and profit from innovative ICT products. The concept of entrepreneurship implies vigilance and alertness. In a recent publication, OECD defined entrepreneurs as the principal actors in innovation, given that they "bring about change in an economy by providing new or improved goods, methods of production, markets, sources of supply of inputs, organization of an industry, or management processes within a firm".[68]

In other words, entrepreneurs are the engine of a national innovation system. They are the main actors in charge of detecting potential opportunities for profitable innovation that matches existing, potential or future market demand. In doing so they combine available information and knowledge to produce and disseminate new information in the form of new products and possibilities for consumption and production. It is important to clarify that entrepreneurs can also be the end users of innovation. They do not need to be producers of knowledge themselves; they can use knowledge produced in universities, R&D labs or anywhere else to develop new products and services.

Of course, entrepreneurs have limited information. This means that the greater the contribution of other actors to the production and dissemination of knowledge and the creation of innovative skills, the easier it will be for them to perform their crucial task for the achievement of progress and prosperity within a national innovation system.

2. *Large firms*

When referring to large firms in the ICT sector, it is worth mentioning a key difference between the manufacturing part of ICT (mostly equipment and device manufacturers and telecom companies) and the services part. In the former domain, large companies take the form of consolidated players that possess the scale, size and technology to carry out R&D activities and develop a large patent portfolio. Such companies are mostly located in developed countries and include device or component manufacturers (including, for example, Siemens, Ericsson, Nokia, Philips, Qualcomm, Huawei, IBM, Cisco, Oracle), telecommunications companies (for example AT&T, Verizon, BT, France Telecom, Deutsche Telekom, Telefonica, Vodafone, Telecom Italia) and cable companies (Comcast, Sprint). While these companies have a long-standing tradition of innovation, they have fallen behind the fast pace of innovation in ICT which was brought over by the advent of the Internet. Today, these large companies act mostly as brokers of innovation, mobilizing resources for innovative SMEs that cooperate with them in the development of new technological solutions.

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[66] The definition given by the European Commission, available from http://ec.europa.eu/enterprise/glossary/national-innovation-system_en.htm.

[67] Porter and Stern, 2002; and Archibugi, Denni and Filippetti, 2009.

[68] OECD, 2010, p. 32.

Current large companies offering ICT services are relatively young when compared to many of the large players mentioned above. Examples include successful software houses such as Microsoft or Sun Microsystems, and application layer champions like Facebook, Yahoo! and Amazon. For many of these companies, innovation is essential for survival. They have to keep on evolving into and developing new platforms for ever-changing environments and requirements. These larger entities have kept the door open to smaller companies with innovative offerings wishing to enter the ICT market in the application and service layers.

An intermediate form of large company that is emerging in the ICT world is that of the "vertically integrated producers", including, for example, such companies as Apple, Samsung and Google that offer a wide range of products extending from infrastructure to hardware, software to middleware, applications, services and content. For example, Google has more to offer than search engine technologies. It has productivity applications (such as Google Docs), operating systems (Android), media distribution (YouTube) and devices (such as Chromebook).

3. *SMEs*

Given their superior flexibility and the reduced importance of economies of scale in the Internet age, small and medium enterprises (SMEs) are increasingly defined as the perfect candidates to play the role of entrepreneurs in a national innovation system. Such scholars as William Baumol refer to a functional combination and coordination of large and small firms as the optimal environment in which innovation can flourish. To be sure, SMEs are universally acknowledged as the real engine of modern economies, where they represent the overwhelming majority of firms.

Against this background, SMEs are targeted by specific policies for entrepreneurship and innovation all over the world. In order to unleash their potential fully, they need to be supported in the search for funds and in the establishment of valuable partnerships for the realization of their ideas and the creation of new products in a market. This is why in most industrialized countries innovation policy reserves a key role for the provision of equity funds and borrowed capital to SMEs that wish to pursue high-risk, high-potential R&D activities aimed at the production of innovative products. Otherwise, SMEs risk remaining stuck in the "valley of death", referred to as the phase in which SMEs have yet to fully exploit the potential of their innovative ideas, and financial markets cannot fully appraise the merit of those ideas, and are thus unwilling to finance an innovative project blindly.

SMEs can play a crucial role in innovation, both in sectors where innovation is essentially disruptive, as well as in sectors dominated by incremental, follow-on innovation. Regarding disruptive innovation, large firms frequently lack the flexibility and adaptability needed for the development of entirely new products. Moreover, large firms that have consolidated positions in their markets normally have more to lose from a disruptive innovation, given that they derive revenues from an already existing product. This is why SMEs are often better positioned for the development of high-risk, high-potential innovation, provided that they can convince financial markets of the viability of their projects.

On the way to becoming entrepreneurs, SMEs face several challenges. Besides funding and the "valley of death", SMEs have problems in developing and attracting key innovation skills that allow them to control and manage innovation internally. SMEs also have difficulties in identifying potential partners for collaborative innovation, as well as opportunities to signal their skills and competences to potential business angels, incubators and open innovation accelerators.

4. *Universities and research institutes*

The role of universities and research institutes in national and regional innovation systems has been widely researched in the literature on innovation. Most often, the identified role of universities and research institutes is that of institutions in charge of producing basic research and new knowledge, which will then be

converted into applied research and new products. This is certainly a major impact of universities and research labs: suffice it to think that the private research labs of AT&T (so-called "Bell labs") have led to the creation of such large server operating systems as UNIX; and that it was a public laboratory, namely, CERN in Geneva, that hosted the research that later gave birth to the web. However, in recent years, universities and research centres have increasingly played another role, that of facilitators of knowledge transfers, open innovation and co-innovation, up to the point that many of them have indeed become platforms and hubs in which innovation is created, coordinated, managed and steered towards societal needs.[69]

In summary, the role of universities and research institutes in modern innovation systems is intimately related to the concept of knowledge creation, transfer and management. This includes, of course, basic research. Currently in the United States, universities perform 56 per cent of all basic research, compared to 38 per cent in 1960.[70] At the same time, the need for universities and research institutes to become more intimately commingled with the other actors of innovation within a broader eco-system has led to the development of the concept of "entrepreneurial university", which merges the concept of entrepreneurship with that of traditionally more static universities, which are now called to enter the world of commercialization of innovation through such emerging practices as technology transfer.[71] Similarly, private research institutes can play a decisive role in the innovation ecosystem as well as in public-private partnerships. More specifically, private research institutes play a significant role alongside universities, through joint labs, and private industries, through joint R&D programmes.

5. *Venture capitalists and business angels*

Entrepreneurs do not always possess the necessary funds to successfully implement their ideas. Venture capitalists can provide the necessary equity funding for SMEs, which in turn allows SMEs to leverage more borrowed capital and reach a sufficient endowment of capital to be able to effectively implement, promote and commercialize innovation. Venture capital can be defined as "money provided by investors to startup firms and small businesses with perceived long-term growth potential".[72] Venture capitalists must be entrepreneurs in the sense that they should be able to identify profit opportunities by looking at existing small enterprises and individual inventors who have ideas that can successfully reach the market. In the United States, venture capital accounts for a remarkable percentage of total wealth and growth. According to the National Venture Capital Association, 11 per cent of private sector employment comes from venture-backed companies, and venture-backed company revenue accounts for 21 per cent of GDP.[73]

Together with venture capitalists, a key role is also played by business angels, defined as "individuals, acting alone or in a formal or informal syndicate, who invest their own money directly in an unquoted business in which there is no family connection, and who, after making the investment, take an active involvement in the business, for example as an advisor or a member of the board of directors".[74] Well-known business angels include Sir Richard Branson, the owner and proprietor of the Virgin group of companies, whose first business venture at the age of 16 was a magazine entitled *Student*. Branson has created a business empire spanning airlines, music publishing houses, mobile networks, stores and more.

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[69] Co-innovation is a term used to indicate the joint creation of innovative products by more than one party, normally including producers and users/customers.

[70] Atkinson and Stewart, 2011.

[71] Clark, 1998 and 2004.

[72] Investopedia. Available from http://www.investopedia.com/terms/v/venturecapital.asp.

[73] National Venture Capital Association and IHS Global Insight, 2011.

[74] Mason and Harrison, 2008.

Business angels normally commit their own funds, whereas venture capitalists commit funds borrowed from other sources. Business angels are acknowledged as being the most important providers of venture capital together with seed funds. Mason and Harrison observe that business angels face lower transaction costs compared to venture capitalists and are able to launch smaller investments.[75]

6. *Government*

Governments are key actors in innovation. As is becoming increasingly clear, markets alone present imperfections, which make it difficult to reach socially optimal levels of innovation. These include, among others, transaction costs, imperfections in the dissemination and sharing of key information related to innovative products and ideas, general imperfections in the marketplace of ideas, imperfections in financial markets and rational biases in consumer demand. All these frictions and imperfections in markets determine the need for government intervention.

Moreover, in recent years, it has become clear that Governments can act in several ways to promote innovation. These include the following:

(a) Direct intervention, which includes providing subsidies for innovation and the adoption of policies that promote innovation in various sectors of the economy;

(b) Regulation, whereby Governments use legal rules to facilitate private bargaining over collaborative innovations. The most important examples of this form of intervention is intellectual property law, legislation on technology and knowledge transfer and a standardization policy that reduces transaction costs in the development of industrial innovation;

(c) Supply-side policies in innovation, including the following: (i) public expenditure to support R&D through grants, tax incentives, public provision of equity funding and public venture capital; (ii) the development of research infrastructures and institutions, from patent offices to university funding to investment in such enabling technologies as ICT technologies, and the provision of training, lifelong learning, and mobility programmes for researchers; (iii) information and brokerage services, such as the production of data and the development of patent databases and portals for innovating firms; and (iv) networking measures, including the creation of science parks in collaboration with universities, the creation of incubators and open innovation accelerators, support for cluster policies, etc.;

(d) Demand-side policies, such as the promotion of user-driven innovation, the use of pre-commercial procurement and green public procurement and support for private demand for innovative products;

(e) Infrastructure policies and digital agendas, which facilitate the development of online collaborative partnerships for innovation as well as innovation hubs and platforms.

B. THE CHANGING NATURE OF INNOVATION

Capturing the evolution of innovation approaches is almost impossible, given the variety, diversity and heterogeneity of terminologies and the theoretical backgrounds that populate the world of innovation studies. Recent years have marked a sea change in the way innovation occurs in various sectors. This is even truer for the ICT sector where the intangible nature of most product and system components make it possible to obtain innovative products through collaborative efforts distributed throughout the globe. At least four major trends can be highlighted, as follows:

[75] Ibid.

(a) *From single-firm to systemic, to collaborative*: Modes of innovation and production have shifted from in-house models based on a proprietary control of the value chain, to the exploitation of network externalities and system effects and the increased customization of products. Today, innovation is increasingly a collaborative, collective effort, rather than the product of a single brain in an R&D lab. Forms of collaboration give rise to new conglomerates governed mostly by weak property rules or even liability rules: the typical examples are "copyleft" rules in open-source software, and fair, reasonable and non-discriminatory (FRAND) licensing agreements in patent pools and royalty-free cross-licensing agreements;[76]

(b) *From proprietary to modular, to granular*: The modularity of products has been on the rise in recent decades, as testified by the pioneering work of Langlois (1992).[77] Increasingly, modularity determines the need for collaboration between producers of complementors, and intellectual property is being (or should be) redesigned to facilitate these forms of cooperation. In cyberspace, modularity becomes granularity; even tiny pieces of the production chain can be provided by individual programmers or producers, then integrated into a single, constantly evolving product, such as open source software or similar collective intelligence efforts;

(c) *From supply-led innovation to co-innovation, to user innovation*: The original paradigm of "technology push, demand pull" in innovation has been relegated to history. Co-innovation is becoming more widespread, especially in the ICT world, but also in other technology-intensive sectors such as pharmaceuticals and biotechnology. In emerging economic sectors, especially in the digital environment, co-innovation is being replaced or complemented by user innovation in which users take the lead in developing new solutions that match their industry needs;

(d) *From closed to semi-open, to (almost fully) open*: As collaboration and granularity become more widespread, product architectures also become less proprietary and are gradually replaced by semi-open and fully open models of production. The need for quality control along the value chain still makes fully open models less viable than semi-open ones. For example, in modern broadband communications platforms such as those found on smartphones and personal computers, proprietary models, including those adopted by Apple in the 1980s, have been supplanted by semi-open models such as the one coordinated by Microsoft, which tried to maximize two-sided market effects by stimulating the widespread development of applications that would be Windows-compatible. Since then, more open models (partly) based on open-source software have gained importance. However, especially in the smartphone and mobile broadband sector, the business models that prevail (for example, Android and Apple iOS) are still semi-open and not fully open.[78] This is due to two main reasons, namely: the need to preserve control of the value chain and the need to reap revenues through the creation of modern platforms. As a matter of fact, a fully open and interoperable model in most cases does not guarantee any revenues to its creator, and basically belongs to the public domain.

More details of some of the new forms of innovation that have emerged in the past few years are set forth below.

1. *Open innovation*

In 2008, OECD reported that the organization of "innovative activities (technological as well as non-technological) across firm boundaries is clearly on the increase, with more balance between internal and external sources of innovation ... Industries such as chemicals, pharmaceuticals and information and communication technology (ICT) typically show high levels of open innovation".[79] Moreover, open

[76] Merges, 1996; Geradin, 2006.

[77] Chesbrough, 2003 and 2004.

[78] Boston Consulting Group, 2011.

[79] OECD, 2008.

innovation implies, "the use of internal and external R&D sources; openness to external business models, a variety of intellectual property generators and collaborations (SMEs, academics, etc.), and a proactive intellectual property asset management. This is leading to an increase in the number of companies collaborating in innovative activities".[80]

In the world of the academic who coined the term, open innovation is a model in which firms seeking to advance their technologies use external and internal ideas, as well as internal and external paths to market.[81] Open innovations bring external knowledge into the firm ("outside-in") and identify new sources of revenue by granting usage rights for innovations created internally to other firms ("inside-out"). While the original perspective of innovation focused primarily on corporate R&D, open innovation has outgrown this narrow view and currently integrates more and different streams and perspectives.[82] One of these streams is frugal innovation.[83]

2. *Frugal innovation*

Frugal innovation is a distinctive approach to innovation, which minimizes the use of resources in the development, production and delivery of innovative products, thereby resulting in low-cost innovation that can become a driver of growth, especially in developing countries. The four main features of frugal innovation are as follows:[84]

(a) Not just cost-reduction: the focus is on making better things, not just cheaper things;
(b) Not just products, also (and often mostly) services;
(c) Not just down-grading existing innovation: rather remodelling goods and services;
(d) Not just low cost, but also high tech.

Frugal innovation refers to innovative products and services that "seek to minimize the use of material and financial resources in the complete value chain (development, manufacturing, distribution, consumption and disposal), with the objective of reducing the cost of ownership while fulfilling or even exceeding certain pre-defined criteria of acceptable quality standards".[85]

India has pioneered this approach to innovation in several sectors. Examples include Tata Motors that developed the world's cheapest car, the Nano, by collaborating with companies from several countries, including: (a) German giant, Bosch, to develop a new engine management system; (b) two Italian companies, I.DE.A Institute and Trilix, to upgrade its styling and interior design; (c) a Japanese company, Toyo, for the engine cooling module; (d) a German company, Behr, for the heating, ventilating and air conditioning system; and (e) India's Madras rubber factory for tough rear tires.

In the ICT world, examples include the $100 laptop.[86] The so-called XO laptop was developed by academic and industrial experts who aimed at providing children in developing countries and poor remote areas access to learning and (at the time of its concept) prohibitively expensive computer technologies. These experts studied the problems that were most prevalent in poor communities, including the low availability of electricity, the lack of classrooms and expensive textbooks to provide a piece of inexpensive, innovative technology that had low power consumption, would be easy to read in the bright outdoors and could be used as an e-reader.

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[80] Anvret, Granieri and Renda, 2010.

[81] Chesbrough, West and Vanhaverbeke, 2006.

[82] Gassmann, Enkel and Chesbrough, 2010.

[83] Tiwari and Herstatt, 2011.

[84] Adapted from Bound and Thornton, 2012.

[85] Tiwari and Herstatt, 2011.

[86] Available from http://laptop.org/en/laptop/hardware/index.shtml.

3. *Living labs*

A living lab is user-centric innovation. It brings users in at a very early stage of the innovation process and depends on their feedback to curtail failures. In this "living" environment, the user is a co-designer, co-creator, co-experimenter and co-tester. The living lab concept is well exemplified by the Siyakhula Project in South Africa, which was launched in 2005 as a large collaborative project between Rhodes University, the University of Fort Hare, industry, government and community. This work was a result of a classical Triple Helix initiative by Telkom South Africa in the constitution of a network of centres of excellence which brought together industry, academia and Government through the Department of Trade and Industry. An existing relationship with researchers in the Anthropology Department at Rhodes University provided a connection and entry into the Dwesa community, a marginalized rural community in the Eastern Cape Province of South Africa with approximately 20,000 inhabitants.

It is important to note that living labs and ICT are closely intertwined. ICT provides the physical and logical layers that bring together the various players of living lab environments. On the physical layer, ICT makes available the network, the networking equipment and the computers that facilitate communication between living lab stakeholders. The logical layer provides productivity tools that facilitate communication and collaboration.

C. SMART SPECIALIZATION: THE CURRENT FRONTIER OF INNOVATION

The trends illustrated in the previous sections, together with advancements in the economics literature, have led to a different way of looking at innovation, which is much broader than the traditional approach to innovation policy as essentially an intramural business decision that can be, at the margin, affected by such external conditions as market demand and public policy measures on intellectual property. By contrast, what is emerging today is the need to develop a holistic view of innovation policy, which considers entrepreneurs as actors in a wider ecosystem composed of several ingredients, from the availability of capital markets and human resources to the quality of infrastructure, the cost of labour, the flexibility of intellectual property laws, the dynamism of rivals, and even the quality of the long-term goals set by policymakers, such as the "green growth" goals. The Strategy for American Innovation in the United States and the European Innovation Union both take this "ecosystemic" view, which, if properly implemented, can lead to a faster achievement of progress to the benefit of their citizens. In the economic literature on innovation, the need for a systemic view of innovation has, in the past decade, become more visible.

The current frontier in the study of innovation and innovation policy is heavily reliant on the concepts of smart specialization, which relies fundamentally on the following two core pillars:

(a) Knowledge ecology, whereby the potential technological evolution of an innovation system depends on existing dynamics and encompasses its adaptation or radical transformation;

(b) Identification of knowledge-intensive areas, particularly given that those areas feature the highest presence of key players in the innovation ecosystem. Such players as researchers, suppliers, manufacturers and service providers, entrepreneurs and users employ their entrepreneurial skills to acquire and disseminate knowledge and detect existing profit opportunities and, ultimately, act as catalysts for the transformation of the economy.

Regions can adopt a smart specialization approach only after a thorough reconsideration of their fundamentals in terms of knowledge assets, capabilities and competences, as well as a detailed mapping of the relative strength and development of the main actors of innovation. According to McCann and Ortega-Argilés, translating smart specialization into regional policy "requires a careful analysis of the role of the entrepreneurial agents and catalysts, the relationships between the generation, acquisition and transmission of knowledge and ideas at the geographical level, the regional systems of innovation, and the institutional and multi-level governance frameworks within which such systems operate".[87] In addition, the issues of

[87] McCann and Ortega-Argilés, 2011.

externalities and interdependence between the region and the rest of the world must be solved. Finally, indicators must still be developed in order to link inputs, outputs and outcomes of the bottom-up activities taking place within the smart specialization approach to regional innovation policy.

The smart specialization approach appears to be an evolution of the slightly older concept of "regional innovation systems", which argues that "firm-specific competencies and learning processes can lead to regional competitive advantages if they are based on localized capabilities such as specialized resources, skills, institutions and share of common social and cultural values".[88] As observed by Doloreux and Parto, the theoretical model of regional innovation systems looks mostly at the main ingredients that explain the difference in the performance of regions based on the availability of key elements such as human resources, infrastructure and learning processes through the interaction of different actors.[89] However, the fact that defining a region has proven quite controversial so far does not allow for a precise categorization and measurement of innovation across regions.

In this respect, part of the literature observed that, rather than regions as a whole, it is metropolitan areas that are best located for innovation, because they offer firms spatial, technological and institutional proximity and specific resources.[90] In addition, more concentrated areas allow for a better implementation of emerging concepts, such as that of industrial ecology.

D. Strengthening innovation in the ICT sector

In the coming years, innovation in the ICT sector could profit from a number of disruptive changes that are taking place in the ICT ecosystem. This section explores the new cloud ecosystem, which represent prospects for big data and machine-to-machine communication – also known as the "Internet of Things" – and the emergence of distributed co-creation as the dominant innovation paradigm in ICT.

1. *Harnessing the cloud*

Internet connectivity and cloud-managed services have become important drivers of innovation. A report issued in October 2012 stated that the app economy, though still in its infancy, had generated 519,000 new jobs in the United States over a period of four years.[91] While statistics for other countries and other regions are difficult to obtain, the geographical location in the United States of the two major app economy companies, Apple and Google, would imply that other regions have not fared as well. In reality, the cloud ecosystem reduces the need for geographical proximity and, in doing so, dramatically reduces the cost of development given that it transcends geographical boundaries and brings researchers and inventors virtually closer to each other.

2. *Big data and the wireless revolution*

In the information revolution, competition and innovation will increasingly take place through the use and elaboration of big data generated by human beings and devices. The largely uncontrolled expansion of the generation and storage of data generated by individual interaction and transactions on the Internet is now posed to skyrocket, owing to the development of the Internet of Things. Machine to machine interaction and data exchange will create new sources of competitive advantage for industry players: those who will possess more information will have an edge over others in cyberspace and beyond. The ever-increasing number of connected devices, which will reach an estimated 50 billion by 2020, will affect the way businesses compete, innovate and organize R&D.[92]

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[88] Malmberg and Maskell, 1997 and 1999.

[89] Doloreux and Parto, 2005.

[90] Audretsch and Feldman, 1996; and also Malmberg and Maskell, 1999, supra note 119.

[91] CTIA, 2012.

[92] OECD, 2012.

3. *Distributed co-creation*

Innovation will continue adapting to ever-evolving times. Distributed co-creation, which is an innovation concept that is growing in acceptance and use, is more open in its approach than the previously discussed open innovation. This new wave in innovation distributes R&D to independent groups of providers and customers who work in parallel to achieve a common goal. Distributed co-creation requires new working models and rules for revenue-sharing and IPR management. Countries, entities and individuals that create and adapt these required models and rules faster than others will ensure the primacy of their innovation initiatives.

E. INNOVATION IN THE ARAB REGION

Despite the broad agreement that innovation is key for enhancing total factor productivity and an integral part of the development progress in modern economies, many highlight the fact that "it is extremely difficult to measure given its constantly changing nature and environment".[93] However, concerted efforts have been made by the international community and specialized agencies to construct measures and indices of innovation to be used as benchmarks in order to assess a country's progress in adopting and spawning innovation, and to compare innovation levels among countries and regions.

According to these indices, the Arab region exhibits comparatively low levels of innovation in the ICT sector. Figure 6 reveals that the ICT Innovation Index of the region as well as that of its individual countries is below the world average the averages of and most other regions. This index is a sub index of the Knowledge Index and reflects performance and developments in variables related to innovation, namely, royalty payments and receipts, patent counts and journal articles.

Figure 6. Innovation Index, 2012

Source: http://info.worldbank.org/etools/kam2/KAM_page5.asp.

[93] UNESCO Institute for Statistics. Available from http://www.uis.unesco.org/ScienceTechnology/Pages/innovation-statistics.aspx.

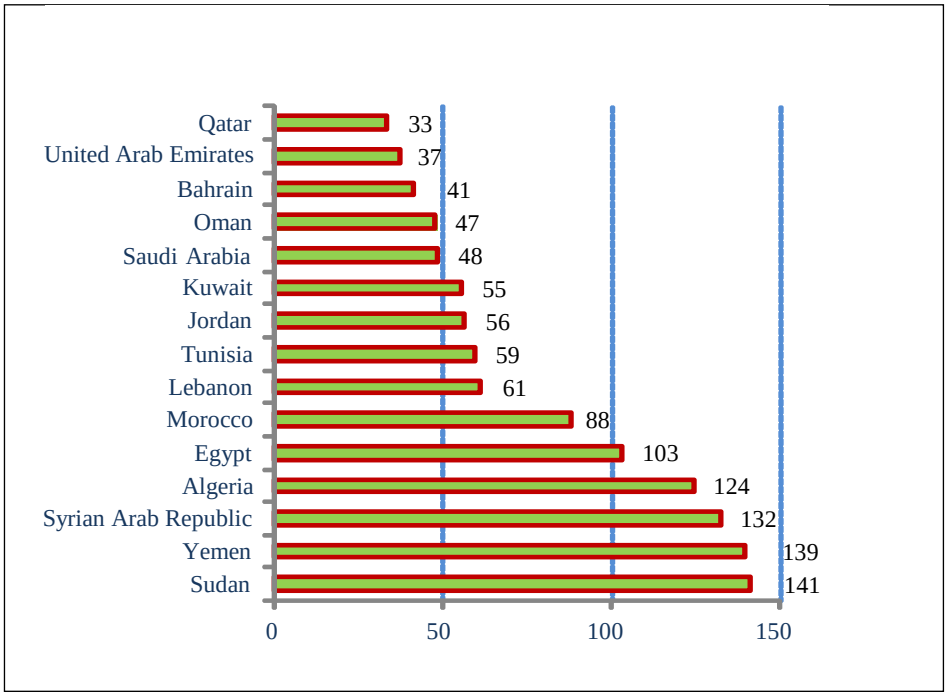
This relatively low ranking in innovation performance is depicted also in the WIPO Global Innovation Index of 2012 comprising 141 countries.[94]

As shown in figure 7, Qatar ranks thirty-third globally and is the highest ranking Arab country in terms of innovation. The Sudan comes at the bottom of the list of all the countries included in the WIPO ranking. Yemen, the Syrian Arab Republic, Algeria and Morocco also rank very low.

This weak performance stems primarily from the region being a late-mover with regard to innovative activities. The World Bank notes that innovation policies are embryonic in the region and, as such, outcomes are still modest in terms of both R&D results and growth of innovative businesses.[95]

Nevertheless, between 2005 and 2011, the number of startups in the MENA region increased eight-fold. During those same six years, Egypt, Jordan, Lebanon and the United Arab Emirates were most successful at attracting early stage investments. The reasons behind the success of the SME sector included the increase in the number of initiatives that took advantage of government programmes aimed at encouraging entrepreneurship and the enhancement of university programmes geared towards developing the know-how of entrepreneurs and investors, as well as the capability of technology parks and incubation centres to adapt to the requirements of the sector.[96]

Figure 7. Global Innovation Index rankings, 2012



Source: www.wipo.int.

Egypt, Jordan, Saudi Arabia and the United Arab Emirates are investing in innovation by creating incubation programmes and by facilitating funding with private equity firms and through government programmes. According to ITU, Saudi Arabia seeks to "encourage domestic companies to build local ICT industries by establishing Free Zones, which are expected to function as incubators for SMEs in the ICT

[94] WIPO, 2012.

[95] World Bank, 2012d, p. 149.

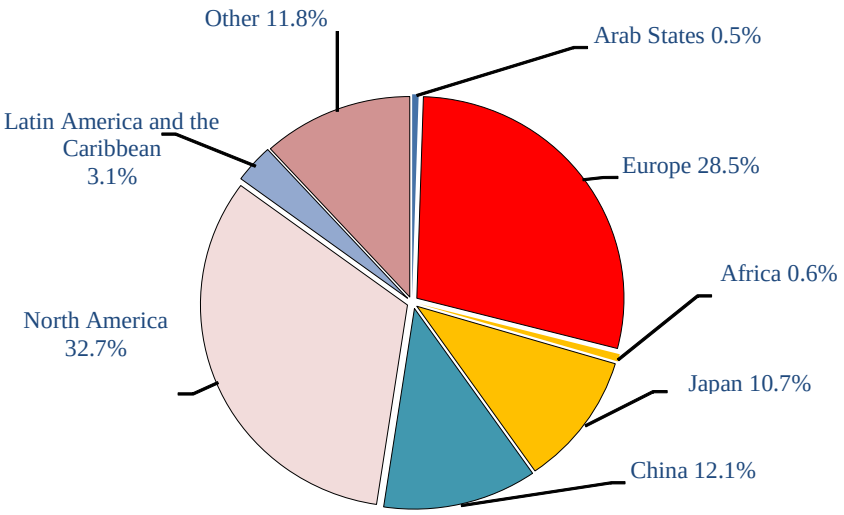
[96] Available from http://www.saudigazette.com.sa/index.cfm?method=home.regcon&contentid=20121018139974.

sector. Further, Saudi Arabia also intends to set regulations on e-transactions for both the public and private sectors in order to enhance the use of ICT for business transactions and government services".[97]

Morocco has set up 22 integrated industrial platforms, including the Tangiers automotive city and the Nouasser aerospace city, and has been able to attract FDI from such major companies as Renault in Tangiers, and Boeing and Safran in Nouasser.[98]

Nevertheless, with respect to innovation infrastructure and activities to create an environment conducive to promoting innovation, Arab countries are still behind other regions. As shown in figure 8, R&D expenditure in all Arab countries was a mere 0.5 per cent of total world R&D expenditures, while the Arab region accounts for about 5 per cent of world population. Brazil's share alone is nearly 2 per cent of total R&D spending, 4 times that of the entire Arab region. Japan, a country with a population equalling less than half that of the Arab region, has a 10 per cent share of global R&D expenditures.

Figure 8. Share of R&D expenditure by region, 2009



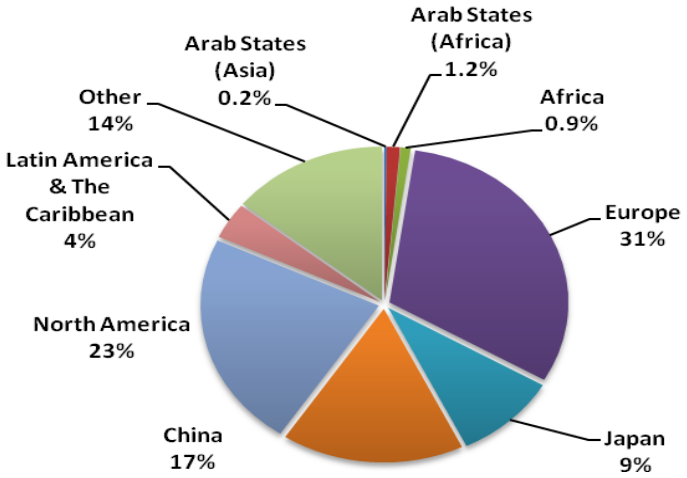
Source: UIS, Science and Technology database.

In addition, the Arab region's share of total world researchers is also very low, standing at about 1.4 per cent in 2009. As shown in figure 9, Arab States on the Eurasian continent have only 0.2 per cent of world researchers, while Arab States in Africa have 1.2 per cent. Japan alone has 9.4 per cent.

[97] ITU, 2010, p. 11.

[98] World Bank, 2012d, p. 149.

Figure 9. Share of world researchers by region, 2009

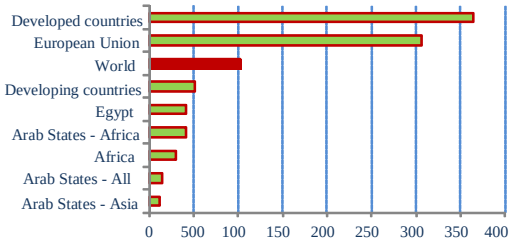


Source: UIS, Science and Technology database.

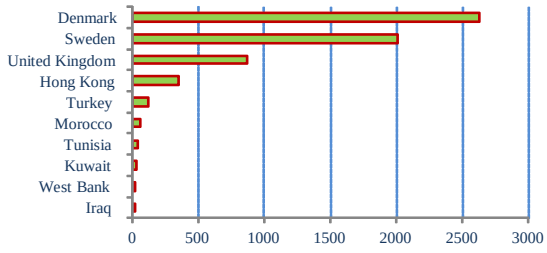
As for researchers per million inhabitants, the region ranks below developed as well as developing countries. Figure 10(A) shows that the region has about 300 researchers per million inhabitants, compared to a world average of 1,027 researchers, and 521 researchers for developing countries. The Republic of Korea has nearly 4,950 researchers per million inhabitants, which is more than 16 times that of the Arab region. Similarly, the number of technicians per million inhabitants in the region is very low. As depicted in figure 10(B), there exists a striking difference between the countries of the region and other countries.

Figure 10. Number of researchers and technicians, 2009
(*Per million inhabitants*)

A. Researchers



B. Technicians



Source: UIS, Science and Technology database.

In order for innovation to take root in the Arab region, it is incumbent upon member countries to enhance the legal, regulatory and business environments. It is essential in this regard that sectoral strategies, including the ICT sector development strategy, be consistent and an integral part of the overall national development strategy. Divergence of strategies would ultimately result in perverse outcomes. At the outset, based on a country's strengths and weaknesses, the sectors in which innovation is needed to complement the national strategy are to be identified, followed by setting specific objectives and a strategy to achieve the agreed objectives.

According el-Darwiche and others, in order to "strengthen their ICT sectors and foster innovation, governments in the Arab region, in conjunction with private-sector ICT players, ought to collaborate and act on five core elements: identifying key focus areas, establishing innovation-friendly policies and regulations, making funding more widely available, improving ICT infrastructure, and developing the local talent pool".[99]

This undertaking must be given the importance and commitment it deserves, which requires efforts in a host of areas that go well beyond the technical field, to include finance, human capital, institutional frameworks, and political commitment. These requirements seem to be lacking in developing countries.

[99] El-Darwiche et al., 2011, p. 1.

V. INVESTMENT IN THE ICT SECTOR

A. INVESTMENT IN THE ICT SECTOR: GLOBAL OUTLOOK

Promoting investment in ICT can be approached in two stages. During the first stage, the essential preconditions to attract and stimulate private investment in the economy as a whole have to be put in place. During the second stage, after the first has been accomplished, policymakers need to draft dedicated strategies aimed at stimulating investment in the various layers of the ICT ecosystem. The sections below delve into the details of the various components of these two overarching stages.

1. *Enabling investment in general*

The attractiveness of a given country for domestic and international investors depends on a number of concurring factors, which are imperfectly reflected in the widely used Ease of Doing Business Indicators.[100] While a full description of those factors would go beyond the scope of this study, it is worth mentioning these factors briefly in order to account for these important features of a national economy in developing policy recommendations for the Arab region (chapter VI). The most essential drivers for promoting investment in general, in other words any sector of the economy, include the following:

(a) *Macroeconomic and political stability*: Investors, who are naturally jittery, pay close attention to the level of risk associated with investing in a given country. They require a reasonable amount of political stability and they want to be assured that there will be no major disruptions in the economic and political system of a given country in the medium to long term;

(b) *The rule of law and the quality of institutions*: Competitiveness-related indicators at the global level are more closely related to governance indicators, such as Kaufmann's Worldwide Governance Indicators than they are with the above-mentioned Ease of Doing Business Indicators. They imply that institutional quality, the reliability of a country's courts, the strength of legal enforcement and the absence of corruption are decisive factors for a company that is deciding whether to invest or not in a lawful and productive activity in a given country;

(c) *Openness of the economy*: The more an economy is open to international trade, the more a country can act as a hub for trade with the rest of the world. This is particularly important in globally interconnected industries that belong to global value chains, or globally interconnected clusters such as those existing in the ICT sector.[101] Countries that apply tariff- and non-tariff measures to isolate themselves from international trade are less likely to be interesting for an investor, with the exception of those investors looking for a niche market and who have no particular need to be integrated into the global economy. Political openness is also a factor that is positively correlated with FDI;

(d) *Market size*: This is one of the more obvious drivers of investment in an economy. Larger markets offer a higher profit potential. Bigger markets, which meet the other drivers mentioned in this section, attract a larger number of entrepreneurs;

(e) *Investment-friendly tax system*: Investors like to maximize their profits; and higher taxes will scare a large number of them away. Countries with an investment-friendly tax system which can compete favourably will attract investors and lure them away from countries with harsher tax regimes;

[100] World Bank, 2013.

[101] For example, Global Value Chains Initiative. Available from http://www.globalvaluechains.org/concepts.html.

(f) *Quality of infrastructure*: The quality of a country's infrastructure can be essential for securing a good return on investment. The importance of a sound infrastructure is discussed in more detail in the sections below.

2. *Promoting venture capital*

In addition to the drivers listed above, some factors are specific to the promotion of private equity financing of high-risk, high-reward entrepreneurs. Venture capital markets look at the depth of capital markets as an essential ingredient of the formula needed to trigger investment.

There are significant differences between capital markets centred on banks and those centred on stock markets. The prior existence of mature stock markets is an important element in the establishment of venture capital and private equity markets. Bank-centred markets, which tend to exert tight control on the financing of debt, may have a negative impact on the availability of funds for startups.

Other factors needed to attract venture capital include taxation, investor protection, corporate governance and, crucially, an entrepreneurial culture. Faced with the lack of such a culture in its member countries, the European Commission launched an initiative in January 2013, entitled the New Entrepreneurship 2020 Action Plan.[102] Its main objective is to reignite Europe's entrepreneurial spirit and is based on the following three pillars: (a) entrepreneurial education; (b) the removal of obstacles to business activity; and (c) the facilitation of better investment opportunities for women, young people, older people and migrants. The initiative brought forth reforms in several areas, including as follows: (a) access to finance; (b) simplification of tax rules and procedures related to setting up and running startups; (c) modification of school curricula to educate youth in matters related to entrepreneurship; (d) mentoring, coaching and training potential entrepreneurs, with an emphasis on supporting women, seniors, immigrants and the unemployed; and (e) helping startups to overcome financial difficulties.

3. *The role of capital markets and stock exchanges for ICT innovation*

The availability of mature financial institutions and a well-developed capital market is an essential precondition for the development of a sustainable, innovative ICT sector. Well-developed financial markets accompany and facilitate the emergence of new ventures. Globally, two models are dominant, namely: (a) the United States model, which is based on a dedicated stock exchange (NASDAQ); (b) a model based on banks, also known as the German/Japanese model. One of the advantages of the first model is that it allows a company to use stock options to cushion the salaries of its employees. This approach turns employees into shareholders, which encourages them to be more productive and more innovative given that they feel that their efforts will ultimately be rewarded.

With regard to developing countries, the unavailability of robust capital market can often represent a key disadvantage for the development of an effective ICT strategy. However, ICT can also be a driver of better capital markets, for example in setting up stock exchanges. In Nigeria, for instance, the stock exchange is a real hub of the capital market in the region, and even Indian ICT companies are being listed on it to be able to develop their operations in the region.[103] The meeting of supply and demand can take place more easily through a stock exchange, although stock values are also affected by fluctuating expectations and global phenomena.[104]

With regard to the Arab region, the fact that some countries possess strong capital markets can represent a key advantage for the development of a sustainable ICT strategy in terms of innovation and

[102] European Commission, 2012b.

[103] For example, moneycontrol.com.

[104] Ilesanmi, 2012.

investment. That said, financial markets alone cannot play the role of innovation accelerators, intermediaries and aggregators. In addition to a well-developed financial market and (wherever possible) a venture capital market, it is essential for governments to design an ICT strategy that relies on existing platforms and technologies to boost development of layer 2 and 3 firms.

4. *Creating intellectual property financial markets*

The organization of innovation in accordance with more traditional, firm-centric R&D models may have become obsolete. In view of the technological progress, the dispersion of useful knowledge and the changing dynamics of the competitive arena, firms are increasingly relying on external sources of knowledge and complementary assets. The self-reliance principle seems to have been replaced by the openness logic that embraces external ideas and knowledge, in conjunction with internal R&D. This leads to a new division of innovative work that underpins the recent diffusion of markets for technology.

Markets for technology, which cater for the use, diffusion and creation of technology, represent the ideal place in which the supply and demand sides meet each other. Among other mechanisms, licensing accounts for the lion's share of exchange of technology that takes place. Technology licensing therefore plays a leading role in the diffusion of markets for technology. By law, a licence agreement is an arm's length contract for the transfer of IPRs encompassing patents copyrights, trademarks and trade secrets. It represents the leading mechanism in trading patents, even though the transfer of the patent itself might not be sufficient to enable the use of the technology by third parties, especially when absorptive capacity is limited. Clearly defined and enforceable patents facilitate licensing and hence dissemination. In this way, patents have become an important currency that allows for knowledge trade to an extent that has not been previously experienced in the markets.

The emergence of markets for technology and, therefore, the diffusion of licensing agreements have two main implications, namely strategic and financial. First, they enhance a firm's strategic flexibility in terms of the number of available options for shaping corporate strategy. Firms focus on what they do best at different stages of the value chain and then sell in the downstream market. Or conversely, they buy other firms' technologies, integrate them into product and sell in the product market. Consequently, markets for technology affect both innovators and users of technology and, therefore, both large and small firms. Large companies may sell or license out their non-core technology but at the same time they may exploit the innovative capacity of specialized firms (for example, biotech) to fill the missing spots of their innovation pipeline. Small firms, instead, may either focus on technologies for which they have developed specialized skills and sell or license them out, or rely on other firms' knowledge base to fill the gap on their innovation road map.

Available information suggests that markets for technologies are growing at an increasing pace. Rough estimates of the size and scope of such markets are the annual amount of patents filed by firms and the total amount of licensing receipts (royalty and revenues).

The success or failure of markets for technology is tightly tied to the emergence of new types of IPR transactions and new ways of developing and sourcing IPRs. On one hand, successful cases emphasize the renting potential of IPRs and, therefore, stimulate (mostly, albeit not exclusively) private actors to design new IPR-based models of exploitation (including, for example, patent pools). On the other, failure cases provide space for market-making firms by highlighting the increasingly relevant role of intermediaries (for example, patent brokers).

Intermediaries allow potential buyers and sellers to find each other, deploy the necessary expertise to settle and conclude agreements, and preserve the anonymity which prevents parties from being disadvantaged against competitors. Intermediaries might also multiply the opportunities for firms to get access to alternative sources of finance (such as venture capital) and equip them with the required knowledge to develop their IPRs, embed them into products and sell them on the market.

(a) *IPR specialist firms*

It is possible to group IPR specialist firms according to their specialized functions as follows:[105]

(a) *Intellectual property management support*: Navigating the IPR landscape requires firms to be endorsed with a high level of legal, business and technical expertise to develop effective IPR strategies. Under such circumstances, many intellectual property specialist firms (for example, ipCapital Group; ThinkFire) have seized the opportunity to provide various services that support and empower patent holders' IPR management. The most frequent services delivered include, among others, patent portfolio analysis and evaluation, competitors' or potential clients' patents due diligence, legal assessment of patent families, prior art and related patents, identification of potential licensees and negotiation support;

(b) *Intellectual property trading mechanism*: As highlighted above, there are several factors that hinder the match between potential licensees and licensors. Sometimes, "patent holders do not have the resources, skills, or relationships with interested buyers which are needed for a successful patent sale" and similarly "most willing patent buyers do not have enough resources and know-how needed to: identify the key patents and their proper market prices; launch and facilitate the negotiations with owners of target patents appropriately; and conclude contracts successfully".[106] In this scenario, the role of intellectual property specialists is to provide services that support and facilitate the transactions and improve the liquidity of the market. The principal business models pursued are as follows: (i) patent licence or transfer brokerage (for example, Fairfield Resources); (ii) online IPRs marketplace (for example, Yet2.com); (iii) IPRs live auction/online IPRs auction and IPRs licence-right trading market (for example, Ocean Tomo); and (iv) university technology transfer (for example, MIT Technology Licensing Office, Isis Innovation, and MI.TO. Technology);

(c) *Intellectual property portfolio building and licensing*: In this case, specialist firms take advantage of the renting potential of IPRs. They develop strong patent portfolios either through their internal R&D activities or through huge strategic purchase (for instance through auction) and license them out to other firms. These firms generally do not operate in the product market (do not use such patents in connection with any product or services of their own). Rather, they establish licensing programmes and gain from the widespread use of patents (mostly as far as standardized technologies are concerned). Sometimes, such firms enable transactions over a myriad of dispersed pieces of IPRs that, owing to the enormity of transaction costs, would never generate revenues. The three business models most frequently embraced are as follows: (i) patent pool administration (for example, Sisvel); (ii) intellectual property/technology development and licensing (for example, Rambus); and (iii) intellectual property aggregation and licensing (for example, Intellectual Ventures);

(d) *Defensive patent aggregation/framework for patent sharing*: This function is similar to the one above. However, in this case, specialist firms (for example, Open Invention Network) seek to acquire "problematic patents that can be asserted before active intellectual property enforcers acquire them, and get them off the street to avoid costly and damaging litigation".[107] Such entities generally allow anyone to use them free of charge. The Open Source Community is an example of such practice. Open-source initiatives are also pursued by private firms, including IBM and Nokia, which are taking steps in developing the Linux kernel;

(e) *Intellectual property-based financing*: These specialized firms provide patent holders with extra sources of finance exploiting the rent-generating potential of intellectual property assets.

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[105] For a complete review, see OECD, 2009.

[106] Ibid.

[107] Ibid.

(b) *Alternative trading systems for IPRs*

Markets for technology and intellectual property assets could have relevant financial implications. In fact, the possibility of extracting value from these assets through market transactions instead of product commercialization potentially allows firms to monetize their intangible assets without bearing the burden of manufacturing products or delivering services. This is particularly important for "Yollies", or young innovative companies with tighter financial constraints. Despite problems of access to equity and debt markets, these firms could raise new financial resources in the intellectual property market.

Possible solutions to raise financial resources in the intellectual property markets include the following: (a) exploitation via licensing; (b) monetization through patent funds or auction markets; (c) leveraging patents to access equity financing by venture capital and business angels; and (d) leveraging patents as collateral for financial transactions (i.e., patent-backed loans, patent securitization, patent sale and leaseback).[108]

Recently, Governments and international institutions have made efforts to promote the exploitation of IPR and, therefore, the transparency and liquidity of the markets for technology. There are a number of policy actions that can be taken towards commercialization, without necessarily adding complexity to the system. These include the following:

(a) Improvement of the patent system;
(b) Improving disclosure of patent and licence information;
(c) Match-making services;
(d) Support of patenting and licensing in public research organization;
(e) Training, education and outreach to small firms;
(f) Regulations and guidelines for exploitation;
(g) Financial incentives for patent licensing;
(h) Valuation tools;
(i) Disclosure and reporting guidelines.

5. *Opportunities and enabling environment for investments in the ICT sector*

Creating the right environment for investment in ICT is certainly a complex endeavour given that the ICT ecosystem is more complex and layered than most other markets. An ideal environment would crucially depend on whether the policymaker is able to ensure that all layers of the ecosystem are adequately promoted and developed. That said, countries might then decide to specialize themselves in one or two specific layers, or in a sublayer (for example mobile equipment or videogames), depending on specific strengths.

Against this background, creating the right environment for investment in ICT is a country-specific exercise, which is likely to entail the following actions:

(a) *Promoting investment in communication infrastructure*: This can be achieved by providing clear and investment-friendly rules on fixed and mobile communications. This type of approach, which was implemented by the United States between 2003 and 2005, boosted investment in optical fibre technologies.

[108] Patent sale and leaseback is a solution that uses patents as underlying assets. In typical transactions, a specialized institution (the lessor) purchases a single or a pool of patents from a company (the lessee). The latter, subsequently, leases patents back from the lessor and obtains all rights to use them in its business activities, paying some interests. The specialized institution usually retains the ownership of the patents until the end of the lease. Patent securitization consists of the transfer of intellectual property by an owner to a special purpose investment vehicle (SPV) for securitisation and the receipt of capital from investors in the form of a lump sum payment. Typically, royalty streams from the intellectual property serve as the income stream to repay capital and interest to investors. Currently, however, the patent securitization market is still in its infancy.

Investment in infrastructure can also be stimulated in other ways, including by public funding of broadband projects, clarifying rules on public-private partnerships and co-investment in broadband networks, using infrastructure clearinghouses and even adopting a nuanced approach to net neutrality, which preserves the possibility for internet service providers to maintain managed services on top of best-effort services.[109] Part of this problem for developing countries is the need to increase the amount of bandwidth available per user, which otherwise represents a key constraint for users located in the global South;

(b) *Investing in education*: Broadband and ICT uptake crucially depend on computer literacy and the ability of consumers to make full use of ICT equipment and networks. Available data show that Internet usage is lower for less-educated individuals among both men and women. A higher educational level generally also implies higher income and greater computer literacy, both of which are important factors that drive Internet use. Moreover, investors in new companies need qualified employees and sufficient human capital to realize their project; otherwise they will try to find them elsewhere. Finally, education also helps to create new entrepreneurs;

(c) *Smart legislation and good governance*: Another key factor to stimulate investment in ICT is the existence and implementation of legislation, especially that geared towards regulating intellectual property and competition. Strong IPRs stimulate both domestic and foreign investment by providing credibly enforced commitments on the protection of property rights;

(d) *Active involvement of government*: Layer III, which includes platform, content and application providers, being global and interconnected by definition, requires less direct intervention by Governments. However, in specific areas, a Government's involvement in the promotion of investment may be essential. Examples include security applications, e-government, e-health and mobile payments, because they exhibit local features, which in turn require legislation that is sufficiently investment-friendly.

The essence of creating the right ICT environment, in any event, is indeed to focus on the fundamental pillars of such an environment, namely widespread and resilient infrastructure, rule of law and education; the rest can be channeled by the public sector towards specific applications and service, but for the most part should be left to the private sector. The latter, as specified above, mainly requires deep capital markets and a fertile entrepreneurial culture.

A publication in 2012 by the World Bank Group takes a similar stance on government involvement with innovation and entrepreneurship in ICT: "To unlock the potential of ICT innovation, governments have to calibrate their interventions. There is a fine balance between facilitating innovation and stifling it with too much intervention. Innovation, mainly led by the private sector and at the grassroots level, relies on creativity's ability to blossom – not a feature usually associated with government bureaucracy. The success of India's IT-based services industry is widely believed to have taken off in the absence of heavy government intervention, other than effective telecommunications and education policies and marketing for major Indian cities as investment destinations. Kenya's m-Pesa thrived thanks to light regulation. Rather than direct intervention, governments should focus on the key enablers of ICT innovation: developing a skilled workforce, implementing ICT innovation policies, promoting ICT entrepreneurship, and facilitating a bottom-up approach to innovation".[110]

[109] Renda, 2010.

[110] World Bank, 2012b, p. 17.

Box 3. Finding the right balance between competition and investment

In December 2012, Brazil and the European Union celebrated 10 years of cooperation in the ICT field with a full week of dialogue and exchange of ideas about innovation, research and regulation. The European Union is an eager exporter of its regulatory models and, in the telecom sector, Brazil was quick to copy the 2002 regulatory framework, which it praised as a solid basis for liberalizing reforms.

However, owing partly to its antitrust rules, the 2002 telecom package centred on the credo that market entrants should not be required to invest upfront in their own infrastructure. Rather, national regulators should help them to grow by ensuring that they had access to networks by former monopolists while they gradually invested in their own network. While sophisticated and elegant in theory, this model, termed the "investment ladder", has required mind-boggling acrobatics to implement.

The United States has experimented with a similar model since 1996 (termed "stepping stones", rather than "investment ladder"). However, when it came to stimulating investment in networks, the regulator decided in 2003 that access policy was a "no-go". When the Federal Communications Commission announced regulatory holidays for companies that invested in broadband networks, investment flourished.

Brazil decided to combine the best of the European Union and United States models, notably when it ran a 4G auction for high-speed mobile broadband long before many European Union Member States. It has opted for the well-shaped European Union telecom package, alongside regulatory holidays for broadband.

Currently, the time could be ripe for the European Union to consider lifting regulatory obligations on investors. The European Union has no reason to return to 27 monopolies, of course. Rather, what it needs to do is to ensure that consumers in any part of Europe have at least two, possibly three, options to subscribe to fixed or mobile Internet access. Unless it does so, it is probable that Brazil will join the broadband fast lane before the European Union – and the European Union's productivity and growth in many other economic sectors will remain stunted.

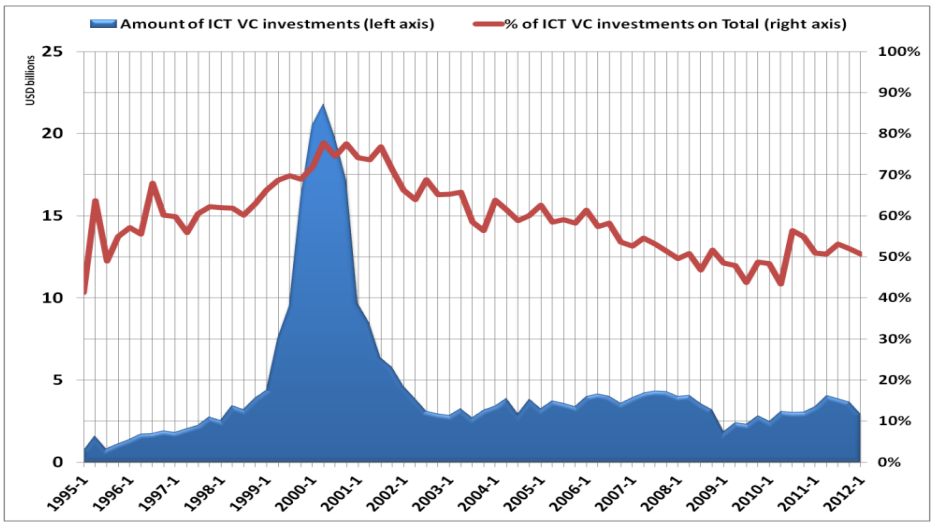
Source: Adapted from Renda, 2013.

6. *Venture capital and research and development efforts*

The ICT sector remains a key area of focus for venture capital investment. In early 2012, it accounted for more than 50 per cent of all venture capital investments in the United States, which is the largest market for this type of investment. After the collapse of the global financial markets in 2001, venture capital financing gradually returned to steady growth. This growth continued at a moderate rate until it started to fall again during the course of 2008 (figure 11). Growth resumed in early 2009. The fact that ICT still accounts for the largest percentage of venture capital investments highlights the perception of future value in the ICT sector. The persistent high percentages of investment in the ICT sector are particularly impressive, given that venture capitalists are increasingly interested in investing in other areas, such as green technologies and biotechnology.[111]

[111] OECD, 2012.

Figure 11. Venture capital investment in ICT in the United States, 1995-2012



Source: OECD (2012).

7. *Business incubation and returns on investments*

Business incubation is a process aimed at supporting the development and scaling of growth-oriented, early-stage enterprises. Incubators typically rely on the concept of industry cluster by establishing proximity with the target enterprise and offering a mix of strategic and operational support, focused on the refinement and upgrading of the original business concept. This is why incubators normally act during the early stages of a company's life, although the business model and overall implementation have to be reasonably defined for an incubator to be fully effective. From this viewpoint, incubators differ from business development centres, which offer ad hoc assistance to entrepreneurs upon request and a pre-determined menu of relatively standardized services; and they differ also from technology parks, which focus on providing the facilities and the real estate needed to trigger the positive effects of business proximity and complementarity.

Adopting a concept of "ecosystem", the World Bank's InfoDev stresses the "ecosystemic" nature of innovation and entrepreneurship and, consequently, the need for innovation accelerators that liaise at once with financiers, academia, policymakers and the business community. Khalil and Olafsen stress that if "any one of these linkages is weak or non-existent, the entire system suffers and the ecosystem is not as effective at enabling innovative entrepreneurship as it could be".[112]

B. Investment in the ICT sector in the Arab region

Acknowledging the decisive role investment plays in the development of ICT sectors, the Tunis Agenda for the Information Society in 2005 highlighted the need for financial mechanisms to bridge the digital divide. It asserted that "attracting investment in ICTs had depended crucially upon an enabling environment, including good governance at all levels, and a supportive, transparent and pro-competitive policy and regulatory framework, reflecting national realities".[113] In particular, the Tunis Agenda recommends improvements and innovations in existing financing mechanisms, including making financial resources more predictable and sustainable, enhancing regional cooperation, creating multi-stakeholder partnerships and developing domestic financial instruments.

[112] Khalil and Olafsen, 2010, p. 70.

[113] ITU, 2005.

In this context, the drive towards building effective and vibrant ICT sectors, as is the case in any other productive sector in modern economies, requires both technical expertise and managerial skills; seed money and venture capital funds; and, in many developing countries, direct government funding to support and encourage the development of ICT projects. This challenge becomes all the more important as projects involve the acquisition of technologies from developed countries and/or require large amounts of capital to finance extensive infrastructure projects. The availability of such funding and the modes of finance differ across countries with direct bearing on the ability to move forward in establishing competitive ICT sectors and promote innovation startups.

1. *Current and potential investment players*

In the Arab region, banks contribute very modestly to startup companies and generally do not have programmes to support entrepreneurial projects. Furthermore, the lack of mature capital markets in the region and initial public offerings (IPOs) in the ICT sector undoubtedly bear heavily on the financing of the sector. According to the World Economic Forum, 10 per cent of the investment expenditures of SMEs in the Arab region are financed by a bank loan, the lowest rate in the world.[114] In view of the minor role played by banks in the Arab region, other arrangements and financing modes must offset this credit shortage. These include government support, public-private partnerships and private equity.

Multinational corporations also play an important role in fostering ICT activities by investing in particular areas of interest and specializations. As a prerequisite to doing business in the region, such corporations need to establish a presence and to set and achieve strategic objectives, such as securing higher market shares.

While SMEs constitute the majority of business activity in the Arab region, bank lending to these enterprises accounts for less than 8 per cent of total lending. In GCC countries, this rate stands at an extremely low 2 per cent. The relative unavailability of funding to SMEs could present an opportunity for private equity and venture capital firms to provide the financial and strategic support that such enterprises need.[115] Another issue highlighted as an effective financing mechanism is the establishment of more multi-stakeholder funds, which pool and coordinate resources to limit duplication and provide targeted assistance.

2. *Problems and solutions*

From the point of view of the private sector, investing in ICT is impacted by country-specific comparative advantages and the quality of the business environment.[116] In this regard, regulatory immaturity, the complexity of doing business and the prevalence of corruption were perceived as the most predominant hindrances to investing in the ICT sector of the Arab region. To attract investment, countries in the region need to enhance the business environment and to dismantle costly barriers to starting a business.

Despite extensive efforts by Governments in the MENA region to simplify business regulations for local entrepreneurs, the region faces structural challenges that can impede private sector activity.[117] A history of government intervention has created more opportunities for rent seeking than for entrepreneurship. Entrepreneurs across the region face relatively weak investor and property rights protections. The private equity and venture capital markets have not developed enough in the region owing to supply as well as demand side considerations. Moreover, it is not only the private equity and venture capital industries that are not offering enough capital; it is also the businesses that are hesitant to relinquish some control of their enterprises to investors, especially in a region characterized by the prevalence of SMEs and family-owned enterprises.

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[114] WEF, 2011, p. 14.

[115] Arab et al., 2012, p. 3.

[116] Braund et al., 2006, p. 24.

[117] World Bank, 2013.

Modes of financing ICT startups could take various forms, including government support and private financing of debt as well as equity stakes. These different forms have varying implications for the fund-receiving enterprises. For instance, while angel capital is not normally associated with high conditionality, venture capital might require entrepreneurs to relinquish partially control of their businesses. Similarly, debt financing has markedly different implications than those of equity financing.

The Arab region's financial enablers are underdeveloped and financial support in the region is focused on very small startups. WEF has suggested that what is missing is funding for businesses with an enterprise value between $500,000 and $8 million.[118]

The network of equity investors is still nascent in the region and the region's banks seldom have special startup or entrepreneurial programmes. This lack prompted several Arab countries to introduce special programmes to encourage banks to increase lending, including exemptions on reserve requirements, credit subsidies and partial credit guarantee schemes. Such government initiatives are not sufficient to create the ideal environment for financing startups.

Governments and the private sector can work together to provide solutions. As an example, the Central Bank of Lebanon announced in January 2013 that it is set to provide credit facilities to commercial banks at the extremely advantageous interest rate of 1 per cent. The relatively long maturity period of 10 years would enable them to provide soft long-term loans at low interest rates to productive sectors of the Lebanese economy, including the ICT sector. It is worth noting that the Central Bank already exempts banks from the statutory reserve requirements on some types of loans, including those that banks extend to the ICT sector.

3. *Venture capital gaining ground in the Arab region*

As an ideal mode of investment, venture capital has been rapidly developing in some Arab countries. While these initiatives are not necessarily designed to bolster investment in a specific sector, the ICT sector is often a direct beneficiary. Some recent examples are set forth below.[119]

In Saudi Arabia, venture capital and overall SME activity increased significantly in 2012. This increase was driven by the following two key factors: (a) overall robust growth of the national economy; and (b) the realization by the Government of the importance of SMEs in economic and social prosperity. Several funds using pure equity or structured equity approaches have been launched targeting the SME sector in the country. The Government has announced several initiatives and programmes to expand financing access to SMEs, and there is even talk of creating an SME-specific authority to promote the sector.

In Kuwait, the Government tried to stimulate the venture capital market in 1997 with a $360 million fund developed by the Ministry of Finance and the Kuwait Investment Authority. The fund was structured to support Kuwaiti entrepreneurs by financing up to 80 per cent of the project costs for startup ventures. Several privately owned companies have tried to invest in the local venture capital market, with great success. One company that is currently trying the bridge the gap between governmental and private venture capital is the National Technology Enterprises Company (NTEC), which is fully owned by the Kuwait Investment Authority but is operationally set up as a private company. It focuses on ICT, among other sectors, where it is actively developing projects in Kuwait and the region by leveraging close links with ministries and the private sector.

In Egypt, the ICT sector has emerged to become one of the most significant contributors to GDP. Fuelled by strong demand for mobile services and infrastructure, the sector has sustained its double-digit

[118] WEF, 2011, p. 14.

[119] Based on Arab et al., 2012.

growth that has enabled local players to go beyond the country's borders. The success of such companies as Orascom Telecom and Raya serves to inspire entrepreneurs and attract venture capital to the technology sector, which is still a relatively new concept in Egypt with only a small number of active players. Egypt's largest and oldest venture capital firm is Ideavelopers, an arm of EFG-Hermes. It manages a $50 million fund that is focused on Egypt and sponsored by some state-owned organizations, banks and insurance companies. Ideavelopers was very active in 2011, investing in three new Internet and mobile companies as well as making two follow-on investments in existing companies in its portfolio. Sawari Ventures is another strong player in the venture space in Egypt. The fund has completed several investments in Cairo and Alexandria, with a particular focus on mobile technologies.

Jordan has a nascent venture capital industry, and 2011 was in many ways a pivotal year that saw unprecedented activity in the sector and the wider ecosystem that supports it. The increase of capital in the venture capital sector in 2011 was driven by several factors: at an institutional level, a number of local and regional institutions entered the market with their first Jordan-focused funds. Funding has also witnessed an unprecedented increase from non-institutional sources, with angel investors specifically showing record interest in venture capital-style investment. Investments into Jordanian ventures also came from international investors.[120] Another global player to enter the sector in 2011 was Cisco, which announced a $10 million commitment for local funds to invest in innovative Jordanian technology ventures.

In Lebanon, the nascent venture capital industry grew in 2011, with $50 million by Abraaj Capital aimed at small- and mid-cap Lebanese companies. The fund closed its first investment in Nymgo, a VoIP company based out of Beirut. Among the most active existing venture capital funds are Berytech Fund and MEVP, whose portfolios have reached 10 and 8 companies, respectively. While Berytech Fund has invested exclusively in Lebanon-based technology companies, MEVP has diversified its commitments across sectors and countries in the MENA region.

In the Maghreb area, Morocco and Tunisia have emerging domestic venture capital and private equity industries that have begun to attract international investors, particularly from Europe. Funds domiciled in the Maghreb raised approximately $746 million in the period 2006-2011. Approximately half of this was from international, mostly European, investors. Algeria and Libya, whose economies have both historically been dominated by state-owned oil and gas sectors, substantially lag behind their two Maghreb neighbours in terms of developing private, growth-oriented entrepreneurship. In recent years, Algeria has made some progress aimed at promoting investment in the ICT sector, including offering infrastructure, helping startups and promoting incubators in collaboration with such international companies as IBM, HP, and ISOC. However, Algeria and Libya have yet to develop advantageous legal frameworks for venture type investment, and lack well-functioning financial and capital markets.

[120] For example, MarkaVIP raised $8 million from a venture capital fund based in the United Kingdom and the United States; and Choozon raised $4.5 million from a consortium of local and global venture capitals and angel investors.

VI. RECOMMENDATIONS

This study identified many of the key strengths and weaknesses of innovation and investment in the ICT sector in the Arab region. For example, major strengths were found in the capital markets and favourable fiscal environment of affluent Arab countries. While not totally absent, these qualities are rare in emerging economies.

This chapter presents a set of recommendations which, if implemented, have the potential to boost innovation and investment in the ICT sector in countries of the Arab region. The proposed recommendations, set forth below, target a variety of sectors, ranging from Governments to various constituents of the private sector. These targets are clearly denoted below each recommendation. An elaborative text accompanies and justifies each recommendation.

1. *Target: Governments*

(a) *Place the development of a competitive national ICT sector at the core of a sustainable development strategy, and commit the human and financial resources necessary to achieve this goal.*

Governments need to set out a clear strategy that opts for ICT as a key driver of smart, sustainable and inclusive growth. The strategy should contain both short- and long-term goals and be launched at the highest possible level. Ministers should then design and implement a consistent, clear and actionable plan for the development of ICT in their sectors of competence. Promoting the ICT sector will help Governments to achieve development goals and will lay the foundation for the establishment of knowledge economies and information societies in Arab countries.

Governments need to adopt a three-layered approach as follows:

(i) At the bottom layer, Governments should focus mostly on tangible and intangible infrastructure and education, and on drafting simple and innovation-friendly legal rules;

(ii) At the middle layer, Governments should merely act as facilitators by providing platforms where universities, centres of research and businesses can engage in fruitful exchange;

(iii) At the top layer, Governments should do the following: (a) demand innovative products; (b) launch a limited set of partnerships to promote the development of solutions to grand societal challenges for which there is limited market development; (c) encourage SMEs to develop innovative solutions that address societal challenges, alone or in cooperation with foreign companies; and (d) steer and coordinate smart cities, smart regions, or cluster projects.

(b) *Develop and/or improve the legal and regulatory frameworks that create the enabling environment necessary for the development of a healthy and sustainable ICT sector.*

Regulatory reform is a crucial milestone for Governments that aim to promote growth. Governments need to adopt freedom of information acts and enable better (and possibly open) access to data. They should run preliminary consultations to involve stakeholders, particularly civil society, academics and consumers, in critical decisions for the ICT development of the country. In order to boost investment in ICT, Governments should also reinforce or adopt clear, ambitious and well-enforced laws on cybercrime, data protection and privacy, and intellectual property protection.

(c) *Undertake steps to liberalize and foster competition in national ICT sectors, while taking care not to create private sector monopolies.*

Governments of many cash-strapped States in the Arab region have a tendency to use publicly owned ICT entities, in particular state-owned telecommunications operators, as cash cows. The strong grip that many Governments in the region have on a significant chunk of the ICT market hinders its development, as it

keeps away local, regional and global investors. Given that these same Governments do not have to fend off competitors, they have no incentive to keep up with technological innovations. Their limited introductions of new technologies are usually attempts to catch up with world trends, often falling short of the expectations of investors and of the country's development needs. Governments in the Arab region need to liberalize ICT markets by moving away from state-owned monopolies to a more open market that allows and fosters competition. Governments should take measures to ensure that this liberalization does not end up creating private monopolies to replace public ones. These measures could include not allowing one particular entity or individual to have a controlling interest in previously state-owned monopolies.

2. *Target: Governments, financial sector, banking sector, international organizations*

Develop sources of funding for startups as well as financing modes and mechanisms aimed at encouraging investment in ICT activities.

Establishing regional funds to support R&D and innovation in the ICT sector could contribute significantly to meeting the major economic and social regional priorities, including innovation-based sustainable growth, creating employment opportunities for new entrants to the labour force and bridging the digital gap. Bank lending, venture capital and private equity must assume a greater role if the ICT sector is to fulfill its potential. Banks must be encouraged to be more willing to lend to startups, and to offer entrepreneurial lending facilities. Existing special schemes to increase lending are to be broadened in scope and scale, including exemptions on reserve requirements, credit subsidies and partial credit guarantee schemes. Equity financing, including seed funds, angel and venture capital funds, and primary and secondary capital markets should be developed further.

Actions that could be taken to implement this recommendation include stimulating equity and debt financing, establishing primary and secondary capital markets, encouraging a more active involvement for the banking sector, promoting business angel networks, creating government support programmes, and securing the provision of assistance from specialized regional and international organizations.

3. *Target: Governments, commercial sector*

Deploy and/or improve national and regional physical infrastructure, putting an emphasis on the development of high-speed broadband connectivity.

Pervasive broadband deployment must be a priority for Arab countries. Governments should aim at affordable connectivity for all in the near future. This could be achieved by rolling out a mix of fixed and wireless technologies and promoting competition between facilities-based competitors. Where economically feasible, the passive infrastructure of all utilities should be opened up to the deployment of optical fibre. Given its high cost, this deployment can only be affordably achieved in densely populated areas. For remote and sparsely populated areas, advanced wireless technologies would be less costly.

Spectrum policy should reserve a number of frequencies for the deployment of wireless broadband applications. The so-called upper ultra high frequency (UHF) band (700 MHz to 860 MHz) possesses the right combination of coverage and capacity to bring high speed Internet at reasonable cost to sparsely populated areas. The Ku and Ka bands are needed for new-generation satellite technologies to bring good speed, good interactivity Internet connections to very remote areas, which are common in some countries of the Arab region. The establishment of local and wide area networks in buildings and compounds and the diffusion of Wi-Fi hotspots in public places should be promoted without restrictions.

Finally, demand uptake of broadband services should be stimulated by improving the personal computer penetration rate and promoting digital literacy among the general population.

4. *Target: Governments, education/academic sector*

Improve education and skills by investing in basic and higher education and vocational training, and by connecting the region's R&D teams with counterparts in developed countries.

Globally, there are an estimated 1.7 million jobs that stay unfilled every year in the cloud computing sector. By revamping education systems and putting more emphasis on ICT-related curricula and vocational training programmes, countries in the Arab region could secure some of these unfilled jobs for their citizens. Improving ICT skills will unleash the socioeconomic potential of ICT by increasing labour productivity and attracting FDI.

The development of ICT skills is not limited to spreading basic computer use knowledge to the general population. ICT capacity-building programmes can also be developed specifically to help specialized agencies understand the requirements and constraints of a society that is increasingly dependent on ICT. For example, law enforcement agents would benefit from education programmes that familiarize them with the concepts and caveats of cybercrime, data protection and intellectual property laws.

In addition, Governments should set up and mobilize a database of those Arab researchers who hold significant positions in foreign-based R&D institutions. Using modern tools such as social networking, those researchers could be linked to local R&D institutions in order to benefit from their expertise in the ICT sector or to lure them back to the region. A similar solution could be sought for Arab entrepreneurs currently active in foreign countries.

5. *Target: Governments, education/academic sector, research sector, business sector*

Adopt a bottom-up, holistic view of innovation in the ICT sector.

In order to succeed, such a view requires the existence of a knowledge triangle that brings together education, research and industry. In implementing this recommendation, Governments need to adopt a three-layered approach as follows:

(i) The bottom layer, which would focus mostly on the development of infrastructure, education and an innovation-friendly legal framework;

(ii) The middle layer, in which Governments would act as knowledge facilitators connecting academia, research institutes and the business sector;

(iii) The top layer, in which Governments would encourage the education, research and business sectors to develop innovative solutions to societal challenges.

6. *Target: All stakeholders at the national level*

Use cutting edge technologies to leapfrog over the technological achievements of developed countries.

Countries in the Arab region can skip over costly and lengthy technological transition periods by adopting and implementing the very latest technologies. Examples can be drawn from such developing countries as Colombia, Indonesia and Malaysia, which have managed to launch 3G and even 4G services in telecommunications ahead of several developed countries, including France, Italy and Spain. On the application front, leapfrogging is possible if Governments stimulate the development of local applications that are compatible with existing dominant platforms (for example, Android, iOS, Windows) and could be included in emerging cloud architectures (for example, Microsoft, Amazon, Google, Cisco and Dell).

7. *Target: All stakeholders at the national and regional levels*

(a) *Adopt a "smart specialization" strategy by carefully selecting the layers of the ICT ecosystem that are deemed to have the highest chances of success*

An innovation strategy for the Arab region must be based on local specificities and strengths. "Smart specialization" is based on the need to analyse a region's unique features, actors and assets. The region's competitive advantages must be carefully assessed before deciding how to allocate funds and mobilize stakeholders in order to develop a coordinated, future-proof vision of regional excellence. Implementing a smart specialization approach must start by establishing a multilevel governance structure, securing seamless coordination at the national, regional and local levels.

The smart specialization strategy in Arab countries should lead Governments to focus on higher layers of the value chain, such as applications and services that require close interaction with consumers and the development of solutions to real-life problems. Once the strategy has been designed, Governments need to do their best to involve local SMEs in the attainment of societal challenges through innovative ICT solutions.

(b) *Seek economies of scale, preferably at the regional level*:[121]

This effort requires the development of a region-wide ICT strategic plan that would identify prospects on a country-by-country level, as well as regionally, and that would implement the following steps sequentially:

(i) Identifying the ICT sectors and subsectors to be developed regionally;

(ii) Ascertaining the comparative advantages/disadvantages of spreading the development efforts of various ICT products across the countries of the region;

(iii) Formulating resource-based strategies based on the comparative advantages and distinctive competencies of individual countries;

(iv) Implementing ICT value chain activities that capitalize on a country's comparative advantages and distinctive competencies.

[121] For example, countries that have funds to invest in R&D but that lack researchers can partner with countries that have researchers but no funds.

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